RAILROAD GAZETTE

FRIDAY, JUNE 26, 1903.

CONTENTS

Milwaukee Shop Improvements of the Chicago, Milwaukee & St. Paul.

[WITH AN INSET.]

More than a year ago the Chicago, Milwaukee & St. Paul appropriated a liberal sum for the enlargement and improvement of its principal shops, located at West Milwaukee, Wis. It was expected that three years would be occupied in carrying the project to completion. The St. Paul builds all of its own cars except sleeping cars and the finer of its other passenger equipment, and also builds many of its locomotives. The average monthly repairs of these shops have been 35 engines, but it became necessary to increase that number in order to properly maintain the motive power, there being over 400 engines directly dependent on these shops for maintenance. This is also the manufacturing point for the entire system. The principal need of the plant was a modernization and enlargement of the locomotive department, and engine terminal facilities, and an entire rearrangement and extensive increase of the yard tracks, including the removal to a new location of the freight car repair tracks.

The tract on which the shops are located lies south of the main line of the road, and between the latter and the Menomonee River. The river originally ran through the tract in a southeasterly direction, and in order to provide needed room for the extension and rearrangement of the yard track facilities the course of the river was changed, the extent of the new channel being indicated on the general plan. The original channel ran in almost a direct line between the extremities of this new part. The river is a small one, the amount of excavation for the new channel amounting to about 130,000 cu. yds. The material was used for filling in the tract between the old and new channel, which required altogether about 200,000 cu. yds., the extra material being brought from other points.

The important feature of the new trackage scheme was the building of the belt line around three sides of the tract, connecting with nearly all of the yard tracks, greatly improving and expanding the facilities for receiving, distributing and despatching cars, and for handling the business of the plant. Formerly all shop traffic had to be moved in and out through the entrance through which the main tracks run just east of the Merrill Park depot. This condition has been relieved by forming the connection to the belt line as shown. All of the tracks in the locomotive storage yard, those east of the power house, and those in the freight repair yards are new, as well as the connections from the belt line to serve the various shop buildings. Light freight car repairs were formerly done on the tracks north of the freight car erecting shop, and the heavy repair tracks, on which some light repairs were also done, occupied the tract between the woodworking shop and the locomotive department buildings, extending southward almost to the river. Their removal enabled the extensions to be made to the buildings of the locomotive department.

This latter includes two-story extensions 150 ft. long, to both the machine and erecting shop, and the boiler and tank shop; and a one-story extension of 200 ft. to the blacksmith shop. The boiler shop was extended by a 70 x 100 ft. ell on the north side of its east end, and a riveting tower was added. The whole of the locomotive department will be electrically driven, requiring a central power station, which also supplies light, heat and compressed air. Proposed extensions include the enlargement of the storehouse, large scrap bins 600 ft. x 50 ft. immediately south of the storehouse, a frog shop 200 ft. x 80 ft. built as an ell to the blacksmith shop, a pattern shop and storehouse, 150 ft. x 60 ft., another engine house, and a large modern coaling station.

Power Station.—While the location of the power station is not by any means central it will be remembered that only the locomotive department is to be electrically driven. The advantage of its location with relation to fuel supply is apparent.

The building is 97 ft. x 100 ft. outside, with an annex for a pump room 16 ft. x 50 ft. The foundations are concrete on piling, the concrete extending up to the windows. The walls, both the outside and the partition between engine and boiler rooms, are brick, and the roof trusses are steel with 27 ft. clearance in the engine room and 28 ft. in the boiler room. The roof is asphalt on 2-in. planking secured to 6 x 12 in. purlins. It slopes toward the center from both sides and in the middle is a large cupola with skylights, and ventilators for the engine and boiler rooms. There is a basement under the engine room, and also between the partition wall and the back boiler setting under the boiler room. The power station floor is of concrete 13 in. thick carried by 10-in. 25-lb. I-beams. The engine room is finished inside above the line of the window sills with yellow pressed brick.

The boiler room contains two batteries of Babcock & Wilcox boilers of 1,200 total horse-power at 150 lbs. pressure. There is space for an additional battery at 600 h.p. When the new coaling station is completed coal may be delivered through chutes into the boiler room, the boilers being hand-fired. Running along in front of the batteries is a concrete-lined trench with sectional steel plate covering, which will be provided with a track and small cars for ashes which may be run outside of the station, picked up by a hoist and dumped into a car.

The breeching for the boilers was made at the shops. The stack has been placed 35 ft. from the north wall of the power house. This was to provide room for the addition at some future time of economizers in this space between building and stack. The latter is of brick, 9 ft. inside diameter and 180 ft. high.

The 14-in. live steam header is supported on stands resting on the boiler setting and vertically adjustable. To prevent vibration of the header a heavy wrought-iron band was bolted around its center and tie rods run to the center of the back and front of each battery, the ties being secured to the I-beam supports for the boilers. Long-sweep bends connect boilers and header. The engine connections leave the header at an agle of 45 deg., and drop down to the cylinders through long sweep bends and Hoppes separators.

The engine room contains two units composed of Nordberg 330-h.p. Corliss cross-compound, condensing engines running at 100 r.p.m., direct connected to Milwaukee 200-k.w. 220-volt, multipolar generators; and a 160-h.p. Westinghouse engine direct-connected to a 100-k.w. 220-volt Westinghouse generator. The relation of the units is such that power may be obtained up to 500 k.w. in steps increasing uniformly by 100 k.w. There is also space for an additional unit. A 1,200-ft. Allis cross-compound two-stage air compressor supplies air at 100 lbs., with 125 lbs. steam pressure.

All exhaust piping is carried under the floor, being swung to the I-beams by special wrought-iron hangers. The annex to the building contains a pit 22 ft. 8¾ in. long on a level with the basement and opening into it. In this pit are a Fairbanks-Morse 10 x 4 x 12-in. duplex, outside-connected, outside-packed boiler feed pump, a Wheeler surface condenser having 1,700 sq. ft. of cooling surface, a 1,250-h.p. Cochrane feed-water heater, and a pump for pumping the water from the condenser into the heater. The exhaust piping is so arranged that it may discharge into the condenser, the heating system, or to the atmosphere. The condenser is equipped with a Cochrane 24-in. vacuum oil separator which discharges through a Morehead trap to the sewer.

An interesting scheme has been employed in providing cooling water for the condenser. The company obtains all of the water for its engines from the city, the average daily consumption being about 300,000 gals. This gives an ample supply of cooling water with power for its circulation through the condenser already provided. A further advantage is that this use of the water raises its temperature and hence is economical for the locomotives using it. The arrangement necessitated a storage reservoir, and a 200,000-gal. steel tank resting on a concrete base was built just north of the power house. The system has just been put into operation, and the power station is not yet carrying its full load, so that it will be sometime before figures from actual results can be obtained. The primary advantage is that the company has no expense for condensing water; the economy that will result from the use of the heated water in the locomotives will be largely a matter of estimate.

The live steam line for the riveting-tower pump, for testing boilers and to furnish a reserve for the blacksmith shop, the exhaust line to the heating system, and the air line are all carried overhead, on poles, from the power station to the buildings. The lines run north from the power station to the center line of the machine shop, pass through the latter just under the eaves and thence across to the machine shop. Spruce poles are used, the method of supporting the three lines being shown in the engravings. The method of supporting the pipes and the layout of the line is such that no trouble from leaky joints is anticipated. The power-house annex also contains a fire pump and a boiler wash-out pump.

Power Distribution.—Connections from the generators to the switchboard are run under the floor. They are carried on glass insulators mounted on cast-iron bracket supports attached to small boards secured to the sides of the concrete engine foundations. The white marble switchboard has six panels, three for the generators, two for power and light feeders, and one for gages and meters. The circuits from the switchboard pass to a distributing tower on top of the building, from which they are carried on poles to the various points around the shops. There are eight circuits in all, the cables from the switchboard for four being of 1,000,000 c.m. area, one of 800,000 c.m., one of 500,000 c.m., and two of No. 000 gage. The power feeders from the station run to distributing centers in the shops. From these centers each large motor is run on an independent circuit, while the smaller motors are put two or more on a circuit, depending upon their size and location.

Machine and Erecting Shop.—The old shop is a three-bay brick building, 112 ft. x 420 ft., with steel roof trusses supported on the side walls and a double row of columns. The extension, built on to the west end, is 112 ft. x 154 ft. and two stories high. The construction is heavy steel framework with brick walls resting on concrete foundations on piling. Two rows of columns carry the heavy steel girders supporting the second floor, on which are being placed a large number of machine tools, some quite heavy. Two electric elevators serve this floor, one within the building, 7 ft. x 11 ft., and the other outside, at the southwest corner, 7 ft. x 14 ft.

The old shop has 18 pits, of which but 16 have been available for repairs, the other two being needed for other purposes. The addition will contain seven pits. After the rearrangement all of the old pits will become available and there will be 25 altogether. With the old shop, on a basis of 16 pits, the square feet of machine shop area per pit was 1,329. The extension increases the machine shop area by 25,000 sq. ft. For 25 pits this gives 1,800 sq. ft. per pit.

The old shop was served by an electric walking crane. The rails have been extended into the new section and a parallel track laid the length of the shop. A 7½-ton crane made by the Whiting Foundry Equipment Co., having a radius of 15½ ft. and a speed of 125 f.p.m., will be added on the track with the old one, and it is expected later to put in a third crane on the parallel track. Engines are unwheeled and wheeled on a drop-table located in the boiler and tank shop building just across the transfer table.

The tool arrangement in the old shop was extremely crowded but all of the old tools are now being rearranged and a large number of new ones added, the work proceeding somewhat slowly as the output of the shop cannot be curtailed in any way. In the new arrangement the tools will be grouped with reference to the particular work for which they are intended and to keep the product moving in one direction as far as possible.

The shop will be motor driven, principally with group drives, there being but four individually-driven tools. The lower-floor tools are divided into four groups, each driven by a 30-h.p. direct-current motor. Upstairs there are two groups comprising 81 tools with 30-h.p. motors. In the general layout of the shop shown the groups driven by each motor are defined. Also all new tools have a triangular black mark across the upper left-hand corner. About 34 per cent. of the total shown are new, as is also most of the equipment on the second floor. The line shaft in the new part is all 3-in., cold-rolled, running in Hyatt roller bearings. On the second floor there will be the tool room, motion gang, rod work, brass work, and air-brake, injector and water pump departments.

The individually-driven Bement-Miles 100-in. wheel lathe, an engraving from a photograph of which is shown, was not designed for individual motor driving, but the method for doing it is apparent from the engraving. A 10-h.p. motor was first applied, but this was found to be entirely too small for the machine's capacity and it was replaced by one of 20 h.p. A test made of a Niles 24-in. individually-driven slotter showed that for reversing, lowering the tool and throwing the feed 16 h.p. was required; for reversing and raising the tool, 25 h.p.; operating between reversals 5.1 h.p. The tool is driven through a countershaft by a 15-h.p. motor, running at 700 r.p.m. The excessive consumption of power for reversals is to be reduced by making a fly-wheel out of the larger pulley of the countershaft.

An interesting tool not yet received is a triple cylinder borer for Baldwin compound cylinders. This tool will bore both cylinders and the valve chamber at one time. It will be supplied by Wm. Sellers & Co.

Boiler and Tank Shop.—This building was enlarged by

making a two-story extension of 154 ft. on the west end and a 70 ft. x 100 ft. ell on the east end of the north side of the building. A riveting tower was also built on at the south end of the east side. The old building, 80 ft. x 420 ft., contained the boiler shop 196 ft. long, the tin shop 60 ft. long, the tank shop 138 ft. long, and the driving-wheel drop-table already referred to. With the new arrangement the tin shop will be moved to the second floor of the extension, increasing the length of the boiler shop to 256 ft. With the ell and the riveting tower this shop will have over 28,000 sq. ft. of floor space, nearly double its former size. The tank shop will be extended to include the lower floor of the new part, more than doubling its size. The west end of this shop is being fitted up for the wheel department, which heretofore has been in the machine shop. The wheel storage yard has been moved from the space south of the east end of the machine shop to a point north of the new wheel department.

The new boiler shop will have 10 pits, also a system of tracks and turntables for handling material and parts, and a special track to serve the riveting tower. A large number of new tools are being added, including a Niles 12-ft. bending rolls, Scully rotary splitting shears, Foote, Burt & Co.'s six-spindle boiler shop drill, Scully punch with 40-in. throat, Baird 80-in. throat tank riveter, Baird No. 1 staybolt cutter, Hilles & Jones No. 2 horizontal punch, and No. 4 single punch, a rotary bevel shear, and a 36-in. single punch. The bending rolls, rotary splitting shears and the first three punches of the list will be individually-driven; the remainder will be group-driven from line shafting by motors.

The riveting tower is steel framework construction with brick walls. It has R. D. Wood & Co.'s equipment consisting of a 17-ft. gap 150-ton riveter, accumulator for 1,500 lbs. pressure, and a 20 x 4½ x 15-in. simple duplex pressure pump giving 150 lbs. pressure. The crane is a Pawling & Harnischfeger 25-ton electric of 25 ft. span; height to rail 66 ft. 7¾ in.

Another important addition is the flanging and annealing furnace. A novel feature of this furnace is the small rectangular openings placed in the front wall, each opposite a flue. These openings are closed by cast-iron plates, easily removable. Their purpose is to enable uniform heating of the boiler plates; as, if one side of a plate is heating more rapidly than the other, one or more of these covers can be removed, reducing the draft and temperature at that point. The 8-in. blast pipe for the furnaces is run in a brick conduit 12 in. x 13 in. inside and covered with cast-iron plates.

The tank shop will contain 13 tracks and the west end is being fitted up for a wheel department. It will have two double-head wheel lathes, one of which is new, a double and a single axle lathe, and a wheel borer. A 30-h.p. motor will drive the group, which will also include some small tools for the tank shop. A new Schaeffer 300-ton wheel press is to be added, which will be driven by a 5-h.p. motor.

On the second floor, which will be served by a 11 ft. x 16 ft. electric elevator placed outside of the building, will be the tin, copper and pipe shop, a work-shop for the electricians, and also storage for new cabs and patterns.

Blacksmith Shop.—This building has been extended 200 ft., increasing its size 40 per cent. The walls of the extension are brick, and the roof trusses are of wood. The most important additions to its equipment are a 6,000-lb. Chambersburg steam hammer; a 3,000-lb. and a 1,600-lb. Bement-Miles steam hammer; an individual motor-driven Hilles & Jones punch and shears; a Bradley hammer, an Ajax No. 2 bolt-header, a cold saw, automatic grinder and two wet tool-grinders. There will be at the west end an axle plant with a 4,000-lb. hammer and furnace for supplying it.

Fans for furnace and forge blast are placed on an overhead platform swung to the west wall and the first roof truss from that end. There are two of these, one a No. 9 Sturtevant and the other a No. 11½ Buffalo forge, each driven by an electric motor placed on the platform. At the opposite end of the building is a No. 9 Sturtevant fan. For the fans at the west end an independent blast pipe leads out from each fan, running over to the north and south walls respectively, and dropping down to underground brick conduits similar to those in the boiler shop, running parallel to the walls, with the center line 24 in. from the wall. These pipes make a circuit of about two-thirds of the shop, and the pipe from the east-end fan makes the circuit of the remaining third. That part of the circuits running transversely of the shop is common to both. Gates are placed in the circuits in such a way as to divide it into three sections, each supplied by an individual fan, or one or more of the fans may be cut out and the circuits supplied by the remainder.

Lighting and Heating.—For yard and general shop lighting, 220-volt enclosed arc lamps will be used. Most of the shop lighting will be by 16-c.p., 220-volt, incandescent lamps, of which there will probably be about 1,600. The buildings will be heated by a low-pressure vacuum return system.

It was not considered profitable to substitute electric driving in the car department, as it has a 500-h.p. Corliss condensing power plant using the waste product of the department as fuel.

Between the blacksmith and machine shops there is a basin with a tank on each side. The two tanks, each holding 54,000 gals., store water obtained from an artesian well pumped by an air lift. This water is used for boiler washing and testing. The suction from the fire pump in the power house is connected to them. The basin is brick, 20 ft. x 42 ft., and 8 ft. deep, and holds 50,000 gals. This basin is supplied from the storage tanks. It also receives the tail water from the car department condenser and the exhaust from the blacksmith shop steam hammers is to be run into it. The hot water thus obtained is used for washing out the boilers, and for filling them up after washing.

A system of standard-gage tracks with turntables is being put in for the movement of material and parts around the plant and through the buildings. There is also a system of roadways around the plant, as shown on the plan.

It is expected to increase the monthly repairs of the shops to 40 engines as soon as the new arrangement is in working order. There are now under way 26 new engines, and these will be followed by the building of 12 large passenger engines. It is expected that the improved facilities will enable new locomotives to be turned out at the rate of six a month.

We are indebted to Mr. A. E. Manchester, Superintendent of Motive Power, and Mr. J. F. De Voy, Mechanical Engineer, for information and data.

Long Passenger Cars for the Monon.

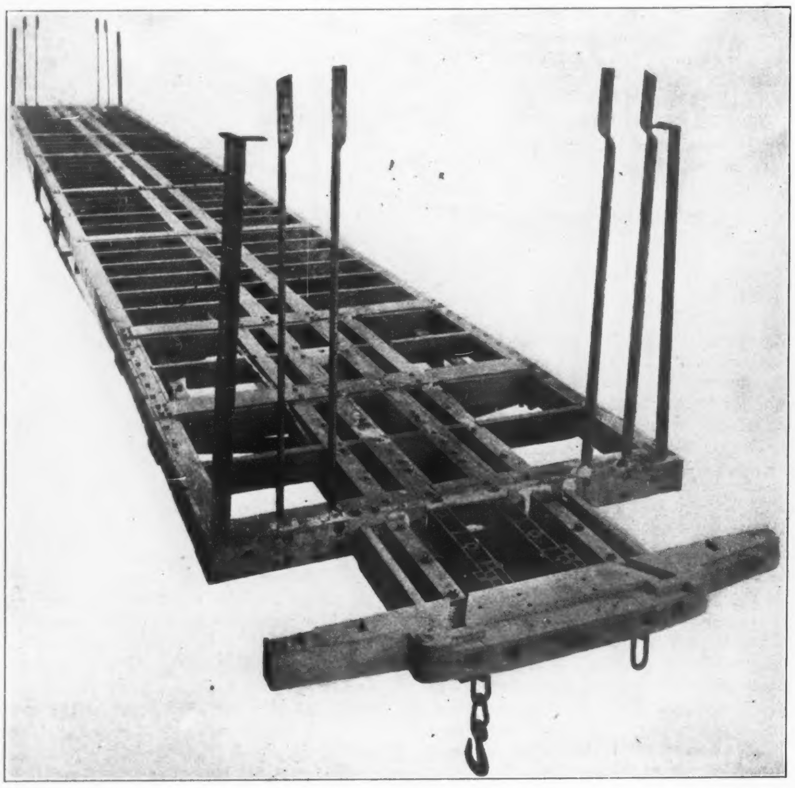
The Chicago, Indianapolis & Louisville is having built at the Jeffersonville works of the American Car & Foundry Co. a combination passenger and baggage car with steel underframe. It is 75 ft. 10¾ in. long over end sills and 9 ft. 7 in. over side sills, the length inside being 75 ft. The baggage room is 49 ft. ⅜ in. long, and the passenger compartment has a seating capacity of 32 persons.

The center and side sills are 8-in. I-beams, 18 lbs. per ft., and the end sills are 8-in. channels 18.75 lbs. per ft. The center and side sills are tied together with 6 in. x ½-in. tie plates riveted to the sill webs and spaced as shown by the plan of the framing. The members corresponding to cross-tie timbers are 7-in. deck-beams riveted to the bottom flanges of the sills. The body queen posts for the four 1½-in. truss rods are fitted over these deck beams and riveted to the webs. On the top sides of the sills, over the deck-beams, are 8 in. x ⅜-in. plates riveted to the flanges of the sills, and also bolted through at four points, with two bolts at each point, to the flanges of the deck-beams.

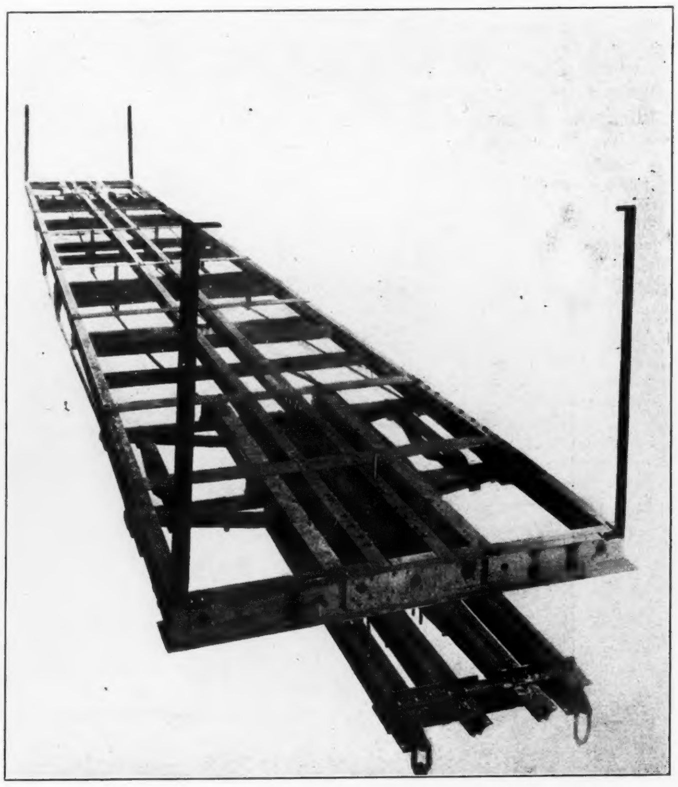
Timbers are bolted to each side of each sill, and the bridging is tenoned into these timbers. Where the bridging timbers come next to the transverse tie-plates they are bolted to them as well. The flooring is a 1¾-in. yellow pine thickness laid diagonally, and a ⅞-in. yellow pine thickness laid longitudinally. The passenger compartment will be finished in quartered oak, and furnished with Wheeler high-back rattan-covered seats. There will be a separate wash room supplied from overhead tanks.

A ladies' coach is also being built, which is 70 ft. 8 in. over end sills, with a seating capacity of 88 persons. It also has the lavatories and saloons separate and is divided midway of its length by an open-spindle bulkhead partition. The interior finish is mahogany. Both cars will be lighted by Pintsch gas and heated with the Consolidated Car Heating Co.'s system. Both cars have the American Car & Foundry Co.'s standard steel platform and the Monon's standard buffer and face-plate attachment. They are carried on the road's standard double-bolster four-wheel truck having 5 x 9-in. journals and 8-ft. 10-in. wheel base and equipped with Norwood ballbearing center plates and side bearings. This has been adopted as standard for all classes of the road's heavy passenger equipment and is giving most satisfactory results, riding as comfortably as a six-wheel truck.

We are indebted to Mr. Charles Coller, Master Car Builder, for illustrations and information.



Framing Sheathed With Wood.



Skeleton Framing.

Steel Underframe for Passenger Cars—Chicago, Indianapolis & Louisville.

The Train Despatchers' Convention.

The sixteenth annual convention of the Train Despatchers' Association of America was held at Nashville, Tenn., on June 16, 17 and 18. Mayor-elect Williams welcomed the delegates on behalf of the city and was responded to by President Caulfield and Secretary Mackie. The President's address congratulated the Association on another year of prosperity and progress. The Executive Committee's report showed an increase in membership of 28 during the year, bringing the total up to 779; a balance in the treasury of $1,141 as compared with $709 a year ago, and a generally prosperous condition. The expense of the official organ exceeded its income by $201, and increased effort to build up its circulation was urged.

The afternoon of the first day was devoted to a trip to the battlefield of Franklin and the National Cemetery at Elkin. In the evening the report of the train rules committee was discussed; and this filled up most of the session.

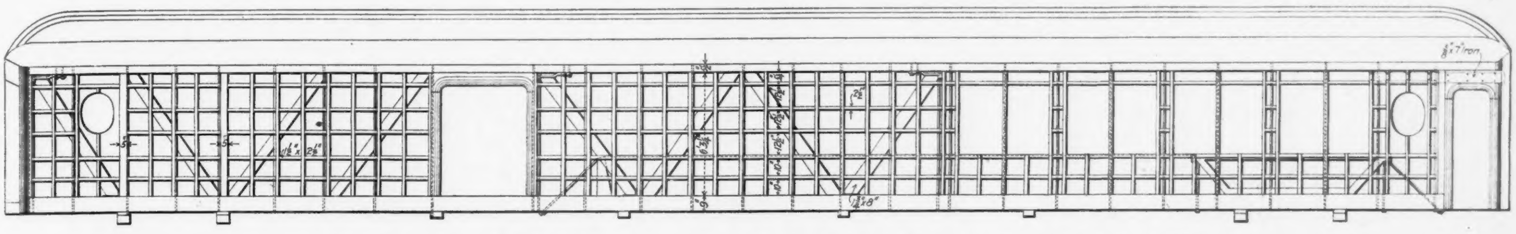
Wednesday morning's session was largely devoted to discussion of proposed changes in the standard code, particularly a recommendation of the Train Rules Committee concerning the use of "train" and "schedule." It was voted to submit to the American Railway Association a question regarding the proper understanding of example 3, Form E, of the Standard Code, which was submitted by Mr. H. A. Dalby.

The afternoon was devoted to visits to the Bell Meade Stock Farm, the penitentiary and the Nashville Railroad Terminals.

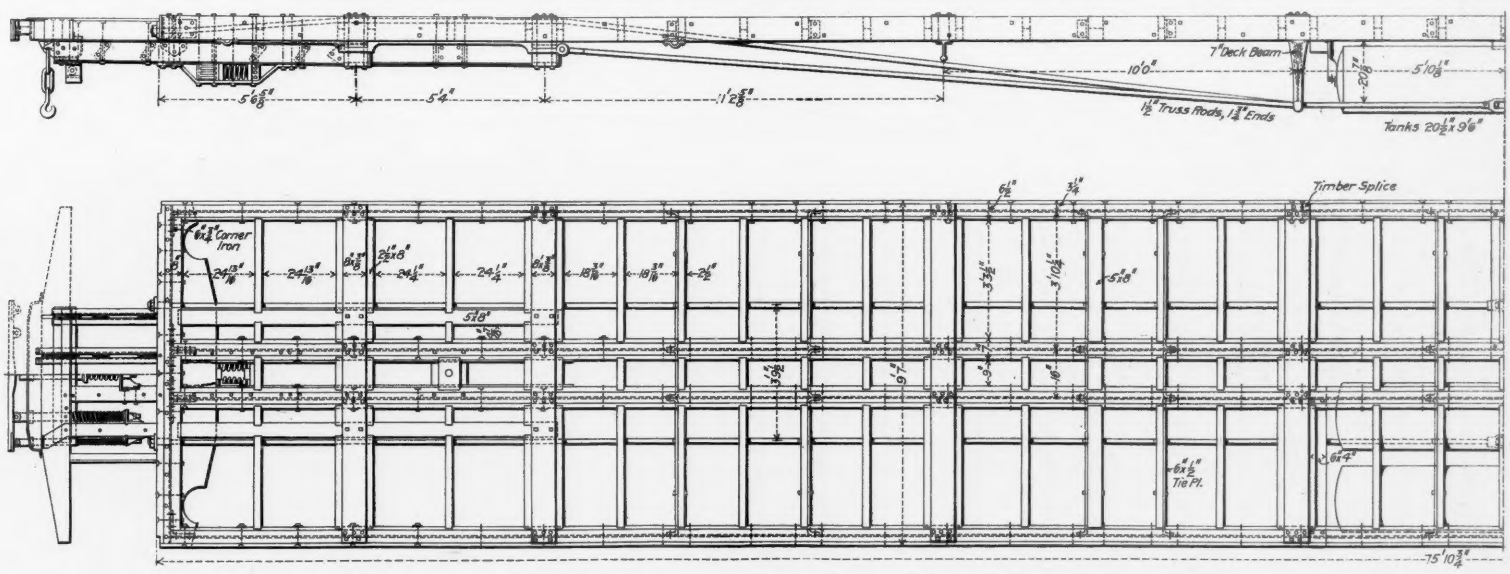
The evening session was occupied by discussion of the question of admitting train despatchers of electric railroads which use the same systems and follow the same methods of issuing train orders as regular steam railroads. This matter was referred to the incoming executive committee. A paper by Mr. H. A. Dalby entitled "A Train and a Schedule" was read and provoked considerable discussion. It was ordered that the official organ be increased to 40 pages a month at the cost of the Association. Also that the surplus cash of the Association be funded in approved securities.

The convention concluded its work on Thursday morning by electing the following officers for the ensuing year: President, F. H. Hadley, Pennsylvania R. R., Media, Pa.; Vice-President, J. R. Lane, Canadian Pacific Ry., Farnham, Quebec; Editor, J. F. Mackie, C., R. I. & P. Ry., Chicago, Ill. The salary of the Secretary-Treasurer and Editor was increased by $200 a year. St. Louis was selected as the place of convention for next year, and the date is June 21.

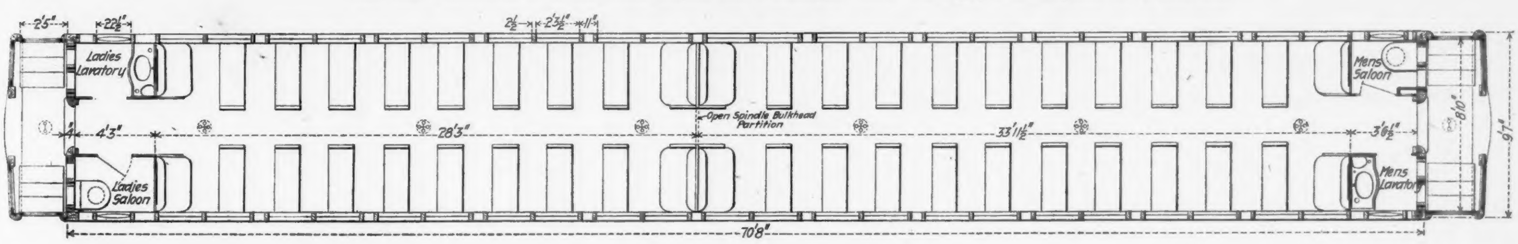
The members of the convention took a trolley ride around the city and environs during the afternoon; in the evening there was a dinner attended by about 100 guests.



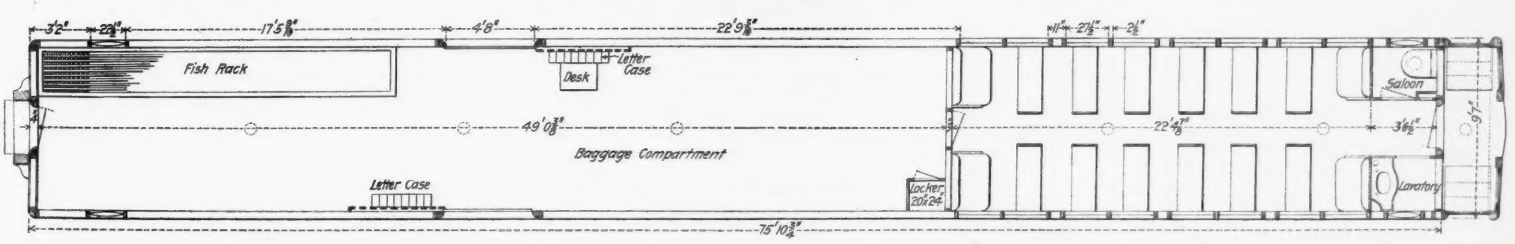
Side Framing for Combination Passenger and Baggage Car—Chicago, Indianapolis & Louisville.



Plan and Elevation of Steel Underframe for Passenger Cars—Chicago, Indianapolis & Louisville.



Floor Plan of Ladies' Coach—Chicago, Indianapolis & Louisville.



Floor Plan of Combination Car—Chicago, Indianapolis & Louisville.

The Internal Combustion Engine in Railroad Service.*

Had the internal combustion engine been invented before the steam engine, it is reasonably certain that the latter would never have assumed the important standing that it has to-day. The internal combustion engine would be in its place, and doing its work more efficiently.

There are inherent losses in the process of converting the energy of coal or oil into power at the crank, which can never be eliminated in the steam engine and boiler. No boiler can be made which will absorb all the heat in the coal. For example, if we take an engine of reasonable efficiency in ordinary service (I do not now refer to the highest type of multiple expansion or condensing engines), with a good boiler, we cannot get a brake horsepower for much less than 5 or 6 lbs. of coal per horsepower per hour. In the present imperfect condition of the internal combustion engine there is no difficulty in getting a brake horse-power for one pound of coal per hour from producer gas.

Gas engines are now made up to 2,500 h.p. units. Formerly the waste gas from the blast furnaces was used in part under stationary boilers which furnished steam to drive the blowing engines for the furnace. These boilers generally had to be supplemented with coal fuel to get enough steam to run the engines. Nowadays the steam boilers and steam engines have given place to powerful internal combustion engines, where the gas from the furnaces is used direct in the cylinders of engines and produces all power necessary for blowing.

Gas producers, operating continuously, have been invented which furnish gas directly from the producer to the engine, and which can be driven with varying capacity just as a steam boiler meets the requirements for steam as demanded by the engine. As gas producers will make good fuel gas from poor coal, without trouble from clinker, and as gas can be successfully used for every purpose in railroad service, not only for producing power, but also for doing work in the shop furnaces, for tinner's work, for blacksmith forges, for welding flues, for flanging and annealing boiler plates, for heavy forgings, for brazing, etc., it is quite practicable at any shop to put in a battery of producers, to turn the cheapest grade of slack coal into fuel gas. This can be used for driving individual shops or groups by gas engines located around the plant, if so desired, the gas being taken to them by piping—for all smith shop and foundry purposes, etc., or, the gas engines can be placed in the central power station and used to drive dynamos for power and light, the current being carried by wire to the machines or motors.

In the West, and in many other parts of the country, where water is bad, where the cost of boiler work is heavy on account of incrustation and scale formation, and where the labor for boiler repairs is scarce and hard to handle, the use of gas opens up possibilities of which it is believed progressive men will not be slow to take advantage.

If the little gasoline engines can drive the heavy automobiles a mile in $52^2/_5$ seconds, which, I believe, is the best record so far, and if the machines can undertake trips of thousands of miles, it is proper to assume that they have become a permanent factor in transportation. What the final effect of this upon railroad passenger service will be, it is hard to predict.

The demand for additional power and for fuel for heating and lighting will steadily increase the demand for coal at the mines, and we will be forced to economize in the consumption of fuel. The internal combustion engine holds out about the only opportunity there is in sight.

The inventive genius of the country will surely provide a means of building locomotives with continuous gas producers instead of boilers, and with internal combustion engines instead of the steam engine. This can be successfully done with crude oil for fuel. Such engines will operate for practically 20 to 25 per cent. of the cost of fuel that is now necessary with the steam locomotive and boiler repairs will be eliminated.

*Abstract of a paper presented to the Master Mechanics' convention June, 1903, by Mr. R. P. C. Sanderson, Superintendent of Motive Power of the Seaboard Air Line.

Bird's-Eye Maple.

BY E. C. HARGRAVE.

So small an amount of curly maple is now found that we will not consider it in this article, although a photograph of a split section of curly maple is shown in Fig. 9.

Bird's-eye maple is found growing with other kinds of maple. The best bird's-eye, or that in which the eyes are closest together and most distinctly marked, is generally found growing where the ordinary or common maple is of poor quality, that is, containing a large number of knots.

It is now the practice in lumbering maple for the bird's-eye maple to be first selected and shipped to veneer cutting mills. This sorting out or selecting of bird's-eye is done by men skilled in the business, who go through the standing timber and mark the bird's-eye maple trees. It is claimed by some good judges that they can tell a bird's-eye maple tree at a distance of 100 yards, some even claim to do it at a greater distance, but the writer thinks a number of trees would be missed at so great a distance.

A bird's-eye maple tree is told by a difference in the habit of the tree. It tapers more rapidly and the trunk is not relatively as long as that of the ordinary kind. It is also told sometimes by the looks of the bark; the bird's-eye maple pits or marks being distinctly seen on the outside of the bark. This is clearly seen in Fig. 1, which shows a section of a bird's-eye timber with the bark on. If there is still doubt as to whether the tree is bird's-eye maple, a blow with an axe will remove some of the bark and after that is done there can be no question, as the surface of the tree, after the bark is removed, clearly shows the bird's-eye marks. This is shown in Fig. 2.

Fig. 3 shows the inside surface of the bark, plainly indicating where the bark filled up the pits or eyes in the log. It will be noticed that the eye of the bird's-eye maple cannot be any kind of a knot, for the reason that the knot always bends the grain of the timber towards the surface, while bird's-eye always depresses the grain towards the center of the tree. This is plainly seen in Fig. 3, and is also shown in Fig. 4, which is a split section looking at the side towards the heart or center of the tree, showing the eyes sticking out towards the observer, or towards the heart of the tree.

After the bird's-eye maple trees are selected they are cut down and sawed into logs and shipped to the veneer factories where they are to be used. It is also customary, where maple logs are got out, for the buyers of bird's-eye maple logs to look over the rollways or piles of logs and select the bird's-eye maple logs. When logs are piled in huge piles or rollways only the ends of the logs can be seen, and these clearly show whether they are bird's-eye or not.

Fig. 5 shows the end of a bird's-eye maple log. The radial lines seen are the eyes. This picture was taken from a very fine bird's-eye maple log, but does not show the lines running through to the heart as is usual in most bird's-eye maple logs. This log was photographed because of the number and distinctness of the eyes shown, although not reaching to the center. From this it will be seen that it is possible to separate all of the bird's-eye from the ordinary maple, and to tell very accurately the class of veneer that will be obtained from any log.

Aside from the logs shipped to the veneer mills there are a few for various reasons that reach the saw mills and other factories. It may be that because there are too few bird's-eye maple logs in the timber to pay to separate them, or it may be that the eyes are too scattering, or that they are only on one side of the log, that is, they appear on too small a section to pay to cut it into veneers. It is strange, and no reason can be given for it, but sometimes the eyes will only appear on one side of the tree, maybe only one-half or one-third the way around it. If such a tree is cut into veneers, only one-third or one-half of the veneer will show bird's-eye marks.

Fig. 6 shows the bark of a plain maple tree, and Fig. 7 a split section of the same tree. Many maple logs are used for the manufacture of toothpicks and for articles such as butter dishes, baskets, etc. In making these the log is first cut into veneers. The best and straightest grained is then put through machines that plane it into round strips the size necessary for tooth picks, and the poorer grades are cut into such forms and sizes as will make the desired dishes or baskets. All logs are not suitable for this work.

Fig. 8 shows what is known as a cross-grained log or tree. The grain travels in a spiral, diagonally up and around the tree. If such a tree could be seen with the bark off, it would look as though the tree had been grasped by the top and twisted. When such a log is cut into lumber or veneer the grain runs diagonally across the piece and it will easily split, making it unfit for veneer that is to be bent, or for toothpicks. Another type of log or tree that is not suitable for toothpicks is shown in Fig. 12. This may be a tree containing a good quality of timber, with a straight grain, and in every other way suitable to be cut into veneers, but the log is hollow, and there is no way to hold it so as to turn off the sheets of veneer.

Timber in which the grain runs irregularly or in waves, out and in, is poor material for veneer, for if a piece of veneer is cut from such a log, and but slightly bent, breaks will appear all over the surface. Practically all kinds, qualities or shapes of logs can be handled and cut up in the saw mills. The logs or trees shown in Fig. 8 and Fig. 12 will make first-class lumber. The sawyer will carefully saw off all the good lumber outside of the hollow in the log shown in Fig. 12. The cross-grained timber shown in Fig. 8 will make good lumber, and although the grain will run diagonally across the board or plank, the saw will make the lumber straight and suitable for practically all purposes where lumber, boards and planks are used.

Considerable skill and care is necessary to properly saw the logs that come to a saw mill, and it is strange to see how few mills handle the logs to the best advantage so that the lumber obtained from them will be of the greatest value. All hard maple, whether bird's-eye, curly, or with ordinary grain, grows with the center of the log or tree of a reddish or brownish color, and the outside almost clear white. The reddish or brownish part of the timber is the oldest part where the sap has stopped circulating, and is known as the body timber. The white is where the sap still circulates, and in the trade is always designated as "the sap." The proportion of white or dark timber in the log varies greatly.

Fig. 10 shows the end of a typical, average maple log, with the usual amount of white and brown timber. Fig. 11 shows a log nearly all white, and though not forming a very large proportion of any lot, logs with this amount or nearly as large a proportion of white are often found. This difference in the color of the timber plays an important part in the value of the timber sawed therefrom, and therefore in the sawing of all maple logs. A piece of bird's-eye maple, or ordinary maple lumber that is cut from the sap wood, is worth from 50 per cent. to 100 per cent. more than if sawed, all or in part, from the heart of the log. The value of the lumber coming from a maple log will decrease as follows:

The most valuable of all, white bird's-eye.
Brown or partly brown bird's-eye.
Plain grained white maple.
Maple squares, i.e., 4 in. x 4 in., 5 in. x 5 in., etc.
Clear thick maple, 2 in., 3 in. x 4 in. thick or over.
Clear thin maple.
Common grades and culls.

Squares are pieces of lumber 4 in. x 4 in., 5 in. x 5 in., or 6 in. x 6 in., sawed out of the good part of the log. It is difficult to obtain a large square free from defects and also very difficult to dry and cure, without checking so badly as to materially lower its grade and value.

If we saw up an ordinary maple log, such as is shown in Fig. 10, the surface of which showed no knots, we will find that the lumber on the outside of the log is free from knots, but as we get into the heart of the log knots will appear and will grow more numerous and larger the nearer we approach the center. The heart is always very defective and of comparatively small value. In sawing such a log, the sawyer after taking off a light slab, then a 1 in. sap piece, would then estimate to the best of his judgment, how thick a board or plank could be sawed that would be all white and show none of the darker

Fig. 1.—Bird's-Eye Maple Bark—Outside.

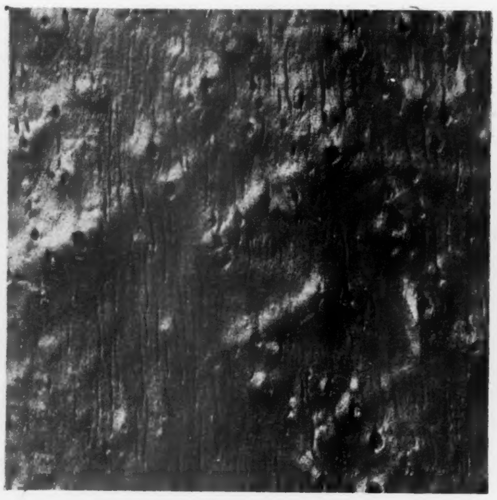


Fig. 2.—Bird's-Eye Maple—Bark Removed.

Fig. 3.—Bird's-Eye Maple Bark—Inside.

Fig. 4.—Slab Section of Bird's-Eye Maple.

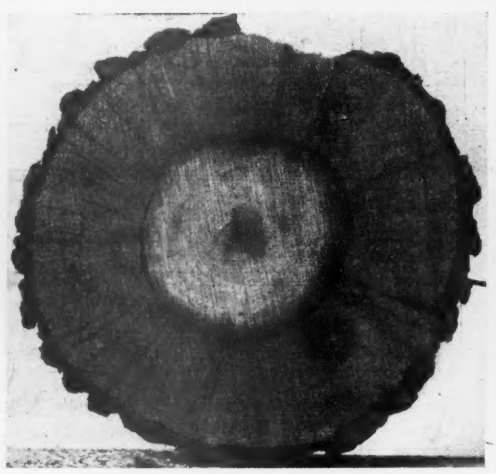


Fig. 5.—Cross Section of Bird's-Eye Maple.

Fig. 6.—Plain Hard Maple Bark.

timber. He must exercise great care, because if he saws off too thick a piece or it cuts into the darker timber, so that part of the board or plank is dark, it spoils the piece for white lumber, and reduces the value. Again, should he saw a thinner piece than could be easily obtained, he leaves more white maple than is necessary on the log to be cut off with the next piece of lumber which is of a much lower value. After cutting off as much white maple as is prudent, he then estimates how thick a piece can be sawed off without reaching into the knots or defects, and thus lower the grade of the thick piece. Here again judgment is required, if he cuts off too thin a piece and leaves part of the good lumber on the log, it will afterwards become part of a poorer piece of lumber, and if he cuts it too thick it reaches into the defects so as to spoil its quality. In sawing a log like that shown in Fig. 11 not so much judgment is required, because practically all of the log is white.

It is important after lumber is sawed that it be properly taken care of. It is absolutely necessary that white maple lumber should be dried standing on end under a shed. Where much lumber is stored large sheds with a good deal of room are necessary for this purpose. These sheds are so arranged that the crossers or small pieces

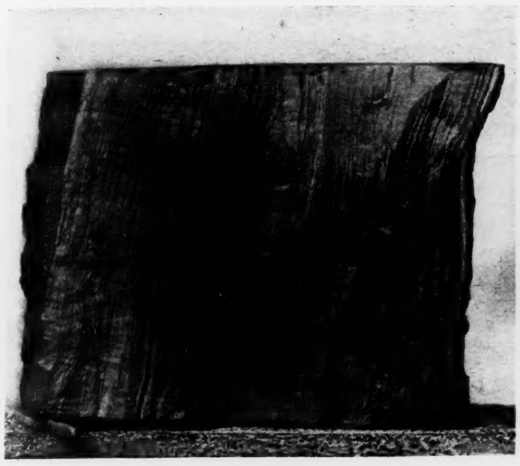


Fig. 7.—Plain Hard Maple.

Fig. 8.—Cross-Grain Maple.

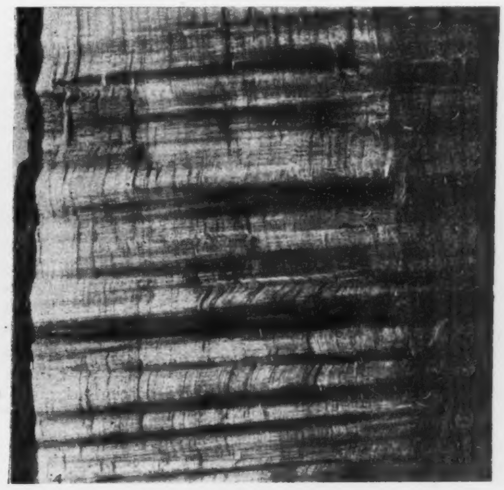


Fig. 9.—Curly Maple.

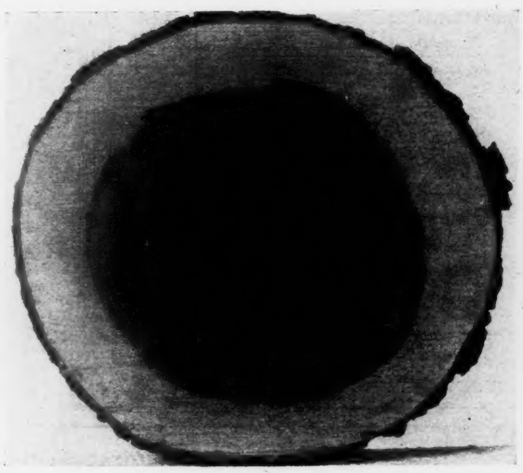


Fig. 10.—Typical Section.

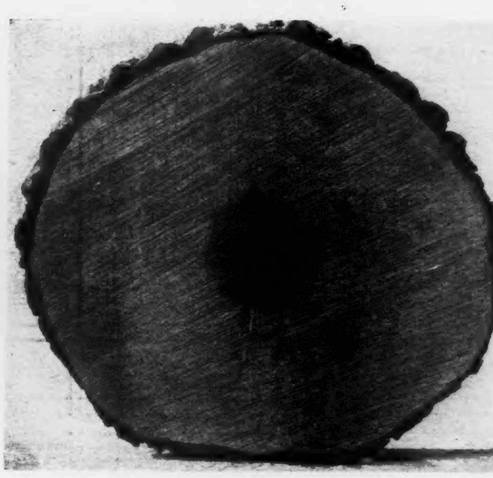


Fig. 11.—Unusual Proportion of Sap Wood.

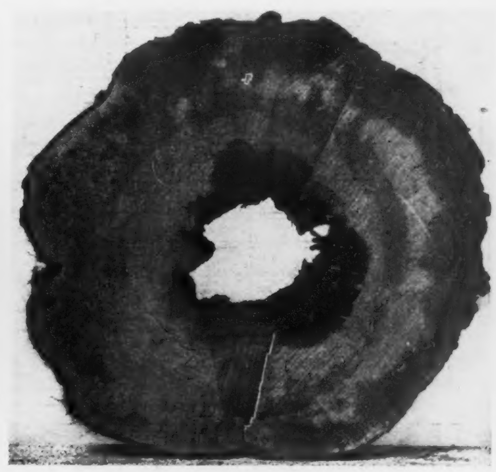


Fig. 12.—Not Available for Veneers.

that hold each layer of boards separate from the preceding one, shall come at the extreme top end of the lumber. If white lumber is piled in the ordinary way with cross boards between the courses, the location of every cross board will show plainly on the finished lumber and spoil it for any fine work.

As before suggested, it is very difficult to dry squares so that they will not check to an extent that will lower their grade, if not entirely destroy their usefulness for the purpose intended. For this reason very few mills will attempt to get out lumber of these dimensions. Lumber over 2 in. thick is also very difficult to cure without checking and increases in difficulty very rapidly as it gets thicker.

The extraordinary snow storm April 19 and 20 interrupted traffic on the lines northeast of Berlin to an extent hardly known before at any season of the year. Between Berlin and Stettin the snow in places was 13 ft. deep, and the telegraph lines were down almost throughout the system of the Stettin Railroad Directory, so that very little was known at headquarters of the actual condition of things. Not till the 22d was the line from Berlin to Stettin cleared. Two trains were blockaded on the track from Sunday till Monday, the passengers spending the night in the cars, and part of them were compelled to spend a second night in the cars. Their journey from Berlin to Stettin lasted 36 and 41 hours respectively, the regular time being 2¼ hours. Telegraph poles and even signal masts were blown down in great numbers. Where were the rotary snow plows?

Railroad Legislation in Connecticut.

BY CLARENCE DEMING.

The session of the Connecticut Legislature of 1903 is memorable, if for no other reason, because it marks the practical close of the long contest of the steam railroad interests of the State against local trolley parallels. Relaxed only by the legislative deadlock of 1891, that contest for ten years and up to two years ago had been incessant; and an act passed in 1893, which made judges determine the question of public necessity and convenience of projected trolley parallels, extended the conflict to the courts. At first the steam interests, represented, in the main, by the New York, New Haven & Hartford, were successful, and in two or three Legislatures signally so. Then began a period of progressive defeat of the New Haven company, affecting first the local and suburban, later, the interurban business. Public opinion generally favored the trolleys, and the trolleys themselves in combination became a force at the State Capitol too strong to resist. The best the great steam corporation could do was to obstruct and delay, and now even those verbs have almost passed out of resistive State legislation as applied by steam railroad interests merely.

But the long period of steam-trolley opposition has ended, only to open up a new period of steam-trolley combination. The old foes have joined forces and pooled interests. Conquest of the territory once achieved the operating trolley companies are as jealous of new parallel projects as was the steam company before them. The New Haven company, owning or controlling several trolley lines in the State, has itself considerable electric interests to protect. And both steam and electricity are blended in the common fear of long distance electric lines promoted by outside or independent capital and which begin to loom up as competitors.

The session just closing has been signalized by what may prove the first stage of this new and broader conflict. An outside syndicate had made the survey for a long distance electric line between Hartford and New Haven, touching at Middletown—a distance somewhat less between the two cities first named than the length of the present steam line. The promoters of the proposed electric line intended that it should be built on its own roadbed and make fast time. Ordinarily such a project in the Connecticut Legislature would have sought a special charter. But the futility of seeking such a charter with the steam-trolley alliance in control of the State Senate was recognized and construction was planned under the general railroad act of the State. The only expedient of resistance in sight was the repeal of the General Railroad Act and a "repealer" for that purpose backed by the steam-trolley interests was accordingly introduced.

Through most Connecticut Legislatures a measure supported by so strong an alliance would have run easily. But it encountered opposition, at first unlooked for, in the so-called "Farmers' Association," a novel body for the first time making its appearance in a Connecticut Legislature and which in future legislatures, as in the one just expired, promises to be a potent factor in railroad legislation. The Association, distinctly of a "granger" character, contained practically all the farmers who were members of the Lower House, numbering ninety out of a total of 255 representatives and controlling others not farmers themselves, but representing farm towns. The Association "caucussed" each week during the session on measures bearing on the "farm" interests and voted adversely on the bill repealing the General Railroad Act as being hostile to the farmers in obstructing the construction of long distance electric roads and forcing such enterprises into the limbo of special legislation.

The "repealer" struck legislative rocks at the outset. The Senate sent it to the Committee on Railroads. The House insisted that it should go to the Judiciary Committee. As contention and disagreement meant defeat of the measure the Senate and the steam-trolley alliance yielded the point. There ensued before the Judiciary Committee and in the press of the State a warm and prolonged discussion on the merits of the "repealer." On the one hand were urged the intrinsic virtues of the existing law with its provision against inflation in the words: "The amount of the bonded and floating debt of any such (railroad) corporation shall at no time exceed the amount of cash actually paid in upon its capital stock"; the danger of substituting special legislation for the general law; and the obstructive power which the repeal bill would give the steam and trolley roads against new enterprises. On the other hand, it was contended that the General Railroad Law, passed in 1875, was an anachronism; that, although it provided for operation of roads "by any power" it was intended to apply only to steam roads; that it had been ineffective in practice, and that it overmuch put vested railroad interests at the mercy of "striking" promoters. A majority of the Judiciary Committee had agreed to report the bill favorably, when the steam-trolley interests suddenly withdrew support and the measure was killed. The plausible explanation was that the Farmers' Association threatened almost sure defeat and that the New Haven Railroad Company, embarrassed by the threatened strikes and the new car detention charge, deemed the time inopportune for feeding a hungry and expectant lobby. Incidental to the contest the New Haven company in its policy of "unloading" yielded without contest two or three local trolley parallels, and it yielded also the famous "Montague farm" crossing of the Connecticut Western Railroad, which had caused so costly a contest in the Legislature of 1901. Why the victorious corporation so readily gave up the point and why the losing corporation—which later "looped" the crossing and could have built it anyhow through a new company under the Gen-

eral Railroad Law—ever entered so expensive a controversy, will remain one of the mysteries of Connecticut railroad polemics.

More direct and telling was the blow with which the organized farmers hit the New Haven road in the matter of the car detention law. Alone among the States of the Union, Connecticut has a statute allowing both the shipper and consignee four days for the loading and unloading of cars—the four days to be computed from the time the cars become accessible to the consignee or shipper and with Sundays and holidays excluded. The statute was passed in 1889, during the great "parallel" fight of the New England and New Haven interests, and when the latter wished to enter the contest unopposed by shippers and consignees. President C. P. Clark and his corporation won the parallel fight, but at the cost of a concession which fourteen years later has returned to vex the company and cause in part an annual loss officially stated at $1,000,000 under the rule of the American Railway Association substituting the per diem in place of the old mileage charge for car detention.

The railroad company sought relief in the form of a bill reducing the four days' detention to two days—later changed so as to reduce to twenty cents per car per day the charge to shipper or consignee for the two days succeeding the first two. Officers of the company had a number of meetings with farmers and manufacturers and the compromise bill seemed to make headway. But the "Farmers' Association" caucussed against it, and although in the Senate only one Senator out of 24 opposed it in the House, only 31 out of 255 members voted for it. The bill died betwen the two houses.

In broader outlines and in forecast the legislative situation thus becomes a striking one. The farmers control one house, the railroads the other, and, in the absence of agreement, there is a deadlock of constructive and positive railroad legislation. Negatively all existing statutes stand unless both granger and railroad assent to change.

As there was no resistance by the railroads the Connecticut grangers put through both houses without much difficulty an act for "State aid" of towns with grand tax lists of less than $2,000,000 and which were bonded to aid railroads a third of a century or more ago. The State is now to pay each year 1 per cent. of the principal of those old railroad debts if the town does the same. No discrimination is made between towns with large debts or small debts or towns that are prosperous or the reverse in this strange piece of socialistic New England law-making.

An interesting, and what may be an important phase of railroad legislation came before the General Assembly in connection with the subject of savings bank investment in railroad bonds. The Legislature of 1899 had opened to investment of savings banks certain bonds of eleven New England roads and of thirteen railroad corporations outside of the State, and specifically named. As a result during the four years savings bank investment in railroad bonds has risen $33,366,000, or more than 92 per cent., and the State with its $214,892,000 of savings bank assets—and trustees subject to the Savings Bank law—has become a rich field for marketing bonds once they are authorized by the statute. The relation of the State law to "undigested" securities is also obvious. There came before the Committee on Banks bills admitting to savings bank investment certain bonds of four Western railroad companies and of three trolley corporations—the Fair Haven & Westville, the Hartford Street Railway and the Worcester & Connecticut Eastern Corporation. There was sharp contention before the committee, the State Savings Bank Association through its officers protesting against the admission of the bonds and charging corruption by the lobby, while friends of the bonds urged that an alleged existing monopoly of present legalized bonds by a New York banking firm should be broken. On a favorable report of the committee the Legislature finally admitted all the bonds except those of the Worcester and Connecticut Eastern—controlled by the New Haven (steam) company and which has not yet been operated for a full year. The admission of street railway bonds is an entirely new departure in the savings bank policy of the State. In that, as in the case of other railroad bonds, the admission of particular securities—a custom sure to promote lobby activity—instead of meeting the question by a general law, is to be seriously criticised. The trolley bonds admitted amount to somewhat more than $4,000,000, or about a quarter of the outstanding bonds of all the trolley companies in the State. One of the two companies favored has been pretty conservatively financed, the other considerably watered, but has high earning power and pays regular dividends on stock.

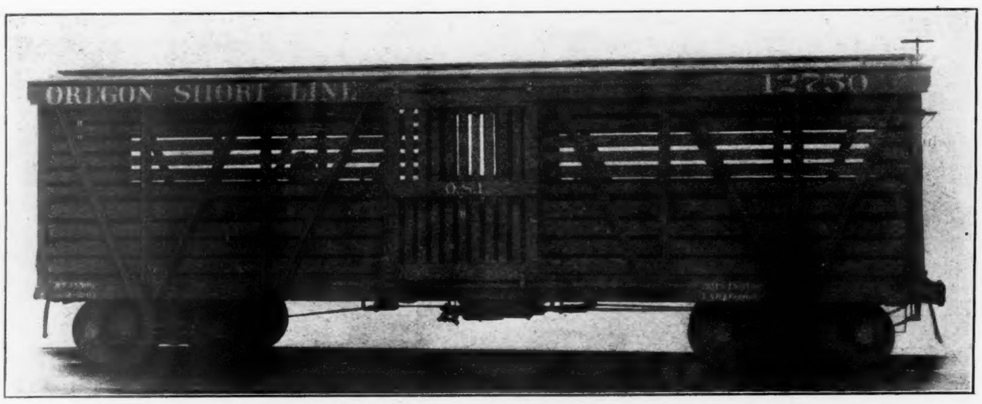
More than 100 plans relating to local trolley enterprise came before the Legislature and many of them went through without resistance. An attempt to shift trolley tax receipts from the State to the municipal treasuries failed—the farm towns profit by the present system—as did a bill—borrowed from the Massachusetts law—for lower street railway fares for school children. A bill, not opposed by the railroad companies, but with somewhat of a bucolic flavor, was passed, providing that any person traveling on a public highway, if blocked by cars at a crossing for more than five minutes, may recover $25 and costs from the operating railroad company. The long session of the Legislature is closing with economic observers in the State wondering what the new and aggressive granger organization means hereafter in anti-railroad and socialistic law-making.

Steel Frame Stock Car—Oregon Short Line.

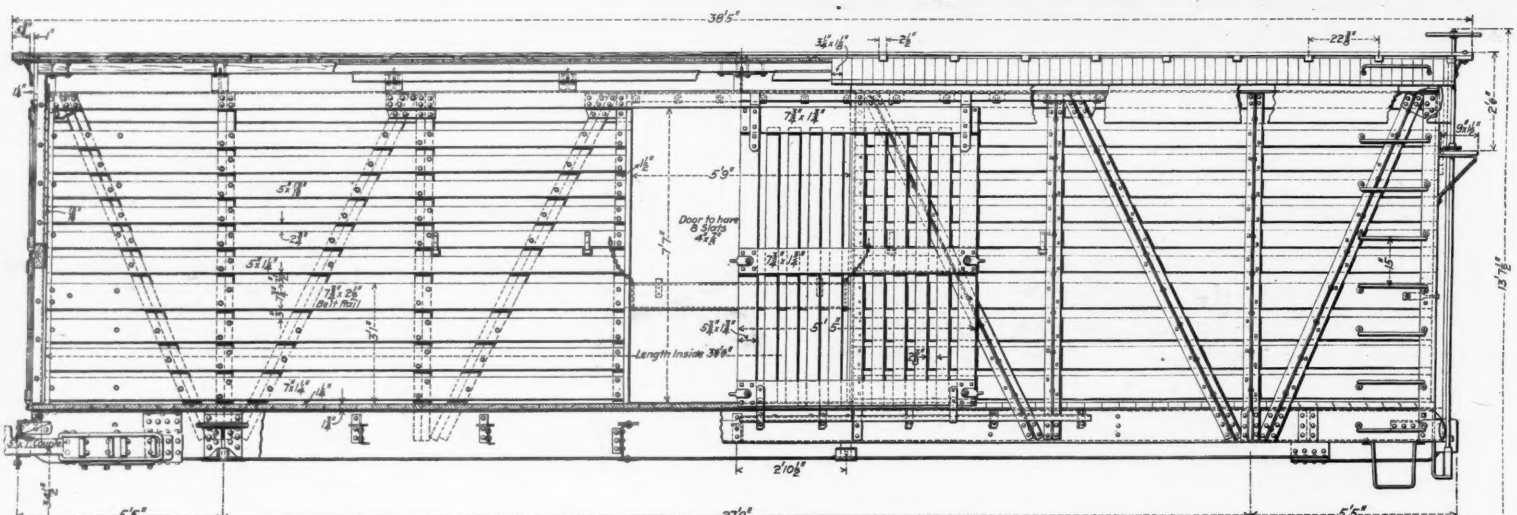
The Oregon Short Line has had built a lot of 300 stock cars which are chiefly interesting because of the use of steel framing for both under and upper frames. They are of 60,000 lbs. capacity, and are 37 ft. 10 in. over end sills, 9 ft. 5/8 in. over side sills, 8 ft. from floor to carlines, and weigh 34,500 lbs.

The center sills are 15-in. channels, spaced 13 in. between webs, and the side and end sills are 10-in. channels. Both center and side sills are spliced outside of the body bolster to facilitate repairs, and also to stiffen the center sills against the thrust on the drawbar follower stops.

The end sill is flush with the end of the car body, and is riveted to the side and center sills by angle plates and gusset sheets. A heavy angle riveted along the top of the web stiffens the sill against buffing strains. An opening is cut in the web and flange, the width of the spacing of the center sills and of suitable depth for the application of the coupler and draft gear. The center sill splices are extended through the opening to the inside face of the heavy pressed steel hood riveted on the outside of the end



Steel Frame Stock Car—Oregon Short Line.



Side Elevation and Plan, Steel Frame Stock Car—Oregon Short Line.

End Elevation of Bolster.

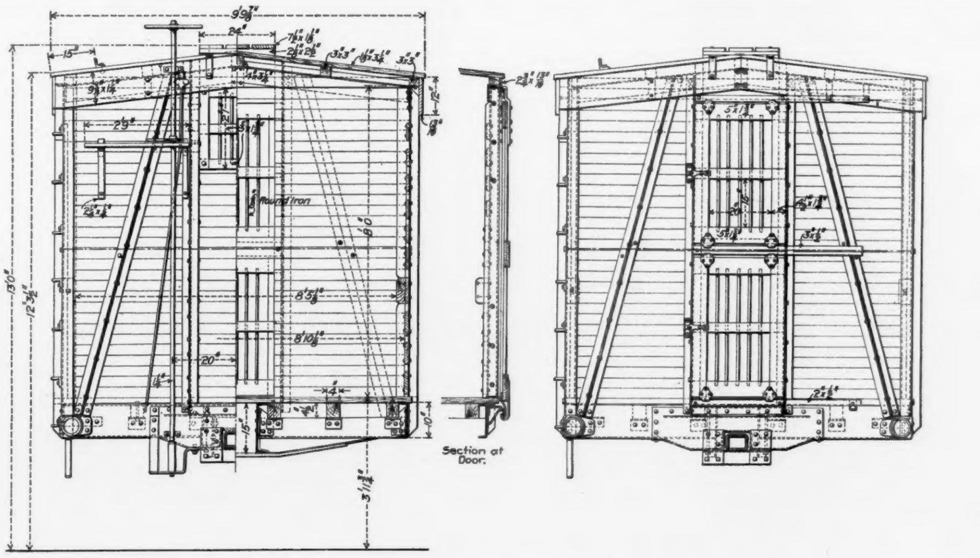
sill which serves the purpose of a dead wood. The bottom edge of this hood is flanged in and the opening through which the coupler moves has all the edges flanged in to act as chafing plates or drawbar guides. The coupler carry iron is a heavy angle bolted through the vertical leg to two brackets riveted to the outside of the hood and through the top leg to the hood itself.

Light transverse channels tie the side and center sills together and furnish support for the 4 in. x 4½-in. wooden floor stringers. The stringers are bolted to angle plates riveted to the backs of the channels. The body bolster between side and center sills is made of plates pressed to channel form with extra-wide flanges, the webs being placed back to back. The top of the bolster is placed the depth of the floor stringers below sill tops and the center sill webs are cut out to allow the bolster cover plate to pass through.

The body and end posts and braces are double angles riveted together, and the side and end plates and the corner posts are single angles with unequal legs. The door posts are formed of two angles riveted together as shown in the plan of the underframe. The carlines are double angles and the girths are wood. A single-board tongue and groove roof, boards 1⅛ in. x 3¼ in., is used.

The trucks are the Standard Steel Car Co.'s pedestal type, this company being the builder of the cars. Other equipment includes Miner draft gear, Major couplers and New York air brakes. More cars of the same type are being built for the Oregon Short Line, which will have 3 in. x 4 in. angles for body braces instead of the double angles used in this lot.

The drawings are shown through the courtesy of Mr. J. F. Dunn, Superintendent of Motive Power.



End Elevations and Cross Section—Oregon Short Line Stock Car.

The Symington Dust Guard.

The Symington dust guard makes a joint against the wall of the dust guard slot and at the same time makes a joint all around the axle. It is made in three pieces—a pressed steel plate, a ¼-in. spiral steel spring and a sectional wooden packing ring.

The steel plate is stamped out by special machinery with lugs A stamped in such position that the spring is always held in its central position and never touches the axle.

A lug C is riveted to the plate and the weight of the guard rests on this lug which has an area of bearing on the axle of ½ sq. in. Lug B controls the hooked end of the spring so that it cannot turn out of its proper position. The inner end of the spring rests on the bearing lug riveted to the pressed steel plate and the weight of the spring is carried by this lug and by the two bottom lugs A on the plate.

To make a tight joint against the wall of the dust guard slot in the box, a tarred rope is laced around the plate; the ends being locked in the lugs D. The spring is designed so that two coils bear against the beveled surface of the wooden packing ring and the entire pressure is exerted in making a joint against the tarred rope.

There is a slight resultant pressure on the wooden ring towards the axle, due to the beveled surface of this ring which causes the packing ring to close on the axle as it wears. Any positive pressure against the axle would cause too rapid wear of the wooden ring. The pressure in this case is just enough so that the jar caused by the wheel striking a rail joint causes the packing ring to close into contact with the axle.

The five segments of the packing ring are joined together by riveted staples, and when the dust guard is in position, the several sections of the ring cannot get out of position, as they are held on three sides between the plate, the spring and the axle. The opening of the packing ring is held on top of the axle by the lug C, riveted to the plate. There is no possibility for the packing ring to turn on the axle. This opening of 1⅝ in. allows the packing ring to wear down ½ in. in diameter while maintaining the dust-tight joint all around the axle. On top of the axle, where the opening comes in the ring, the plate is in contact with the axle, making a continuous joint all around the axle.

When the dust guard is applied, the spring is compressed so that the total thickness of the guard is ⅝ in., allowing it to be readily placed in the ¾-in. standard dust guard slot. The packing ring is pushed out to its largest diameter, and this allows the packing surface to come flush with the edge of the inner hole in the plate. This hole is $^1/_{16}$ in. larger in diameter than the collar or dust guard seat on the standard axle, which makes the guard easier to apply than guards designed to closely fit the axle on the sides when new. It is difficult to get the box on the axle when this fit is close. The heavy spring pressure holds the plate solidly against the box so that it is practically part of the box, and while its weight is resting on the axle, there is no vibratory movement and very little wear.

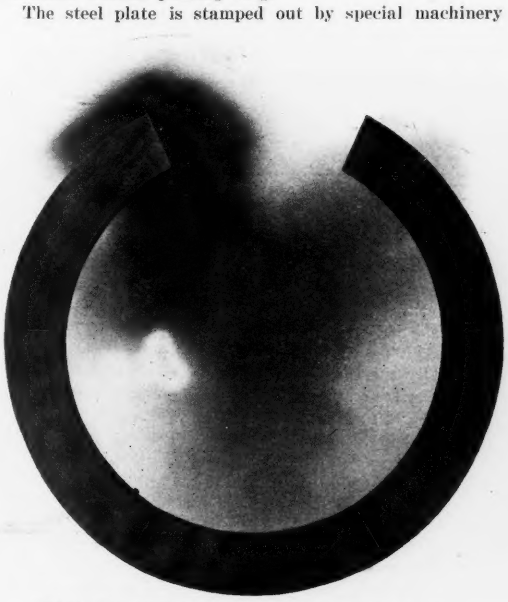
A wear of from $^1/_{64}$ in. to $^1/_{32}$ in. in the top of the plate after 60,000 miles of service under locomotive tenders is all that takes place. After making from 50,000 to 60,000 miles, these guards when removed from the box are in good condition, the packing ring showing that it had been making an effective joint all around the axle.

As the wear on the plate is so very slight and as there is no wear whatever on the steel spring, it is only necessary when wheels are removed from a car to renew the wooden packing ring and replace the dust guard in position. The segments of the wooden packing ring are made by special machinery out of close-grained wood, and are guaranteed to render efficient service for 50,000 miles. These packing rings are very cheap, and after two or three renewals this guard pays for itself over other forms of dust guards, since it may, unlike the others, be put back into a journal box after it has been in service for some time, and removed when wheels are renewed.

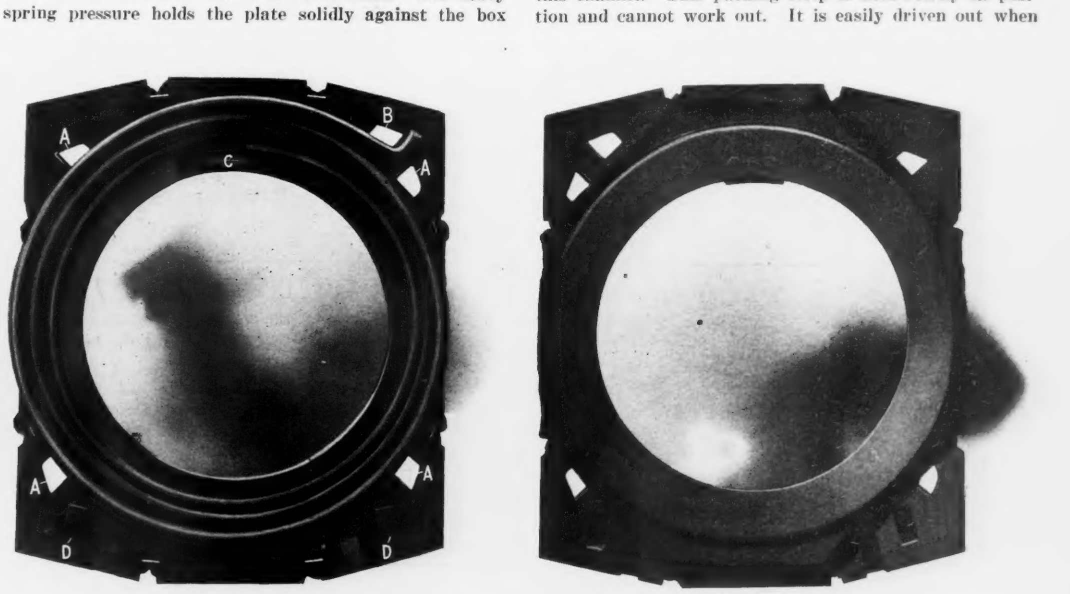
When a box is jacked up to renew a brass, the wheel is frequently lifted, because the dust guard sticks in the slot. This difficulty is not experienced with the Symington dust guard, because it makes a joint against the back wall of the dust guard well and prevents any dirt from getting beneath the guard. When the box is jacked up the dust guard slides easily in the box. Many dust guards have spring arrangements for pulling two pieces of wood or fibre or other material together in a vertical direction, and the positive pressure on the two sections of these guards against the axle soon causes the guard to close to its limit. These guards do not take up wear on the sides of the journal, caused by the slight, incessant movement of the axle in the box, due to the side play between the brass and the box. Guards of this type are made ⅝ in. thick, and are placed in the standard ¾-in. slot, which leaves ⅛ in. clearance for dust and grit to get around or underneath the dust guard and into the box. Dust guards made of fibrous material to fill the dust guard slot and by their own elasticity to make a joint around the axle, soon become saturated with oil and lose their elasticity. When the box is jacked up, the dust guard is mashed down and does not return to the axle when the box comes back into normal position.

In the earlier forms of the Symington dust guard the plate instead of being made of pressed steel was made of a gray iron casting. This casting would sometimes break in service, allowing the jagged edges to cut into the axle and the segments of the wooden packing ring to get out of position. This trouble is overcome in the present form of pressed steel plate, and tests that have run over periods of two years in continual hard service have demonstrated that there is no appreciable wear on the dust guard seat of the axle due to the weight of the soft steel plate. The wooden ring is now of much heavier section than in the first guards made, and as the staple holes are drilled there is now no splitting of the segments.

Most railroads close the top of the dust guard slot in the journal boxes with a piece of wood. These plugs dry out, become loose and are lost in service, and are frequently not put back when wheels are renewed. For this reason it is better to open the dust guard slot on the bottom instead of on the top of the box, because should the wooden plug be left out there is more chance for dirt to get into the box with the slot open on top than with the slot open on the bottom. The dust guard slots have not been opened on the bottom because a wooden plug driven in to close the opening would fall out at once. This difficulty has been overcome in the Symington journal box by the method of closing the dust guard slot. A channel is cast through the box from one side to the other and a wooden packing strip is driven into position from the side of the box to completely fill this channel. This packing strip is held solidly in position and cannot work out. It is easily driven out when renewing the packing ring in the dust guard. These packing strips are placed in all Symington journal boxes equipped with Symington dust guards.



Wood Packing Ring—Symington Dust Guard.



The Symington Dust Guard.

The Chinese Empress and court last April made the journey to the tombs of the Emperors at Hsiling by railroad, requiring for that purpose no less than 150 cars. The composition of the imperial train was as follows:

In the first car, the railroad officers and inspectors; two and three, litters, etc., to carry the party from the Hsiling station to the tombs; four, parlor car for the imperial body guard; five, Prime Minister; six, General Secretary; seven, the Emperor; eight, the Viceroy resident in Tientsin; nine, the Empress Dowager; 10, the young Empress; 11, princesses and ladies-in-waiting; 12 and 13, eunuchs; 14 and 15, high officers of the court; 16, horses, etc. Pullman would have been in his glory there. The court used this railroad once before, on the return from the interior after the capture of Pekin in 1900; and the incident may have much significance for the future of railroads in China.

Modern Steel Cars.

[WITH AN INSET.]

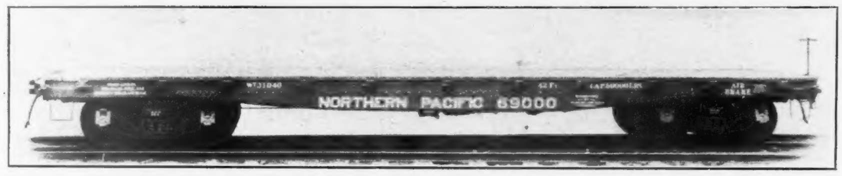
It is only six years since the first pressed steel car was put into general service and in that time the use of the steel car has grown to tremendous proportions. The Schoen Pressed Steel Company, in 1897, built the first pressed steel cars for the Pittsburg, Bessemer & Lake Erie. On the first of June, this year, there was approximately 100,380 pressed steel cars in service. While this is a comparatively small proportion of the total number of freight cars in the United States, it still shows the rapid growth of the industry. Several companies have entered the field in competition with the successors of the Schoen Pressed Steel Company, and each has developed types of cars along original lines. The engravings shown herewith and on the inset accompanying this issue, are all selected from the product of the more important companies now building steel cars, and they represent the latest types.

The one type of car in which steel has almost entirely superseded wood, is the hopper car. The present design of hopper car, having the floor slope from each end toward the center and a ridge in the center of the car so arranged as to discharge the load from two hoppers toward the center of the car, has come into general use since the first steel cars were built. The cars of this type built by the Pressed Steel Car Company are characteristic in that they use both side and center sills of the fish belly girder shape made of pressed steel. Comparing, for instance, two designs of cars built for the same service—that of the Pressed Steel Car Company for the Atlas Coke Company, and that of the Standard Steel Car Company for the Lehigh Valley—it will be seen that they have a similar general exterior appearance. In the Lehigh Valley car, however, the side plates are brought down outside of the side sills, which are not intended to carry a large part of the load. In the car for the Atlas Coke Company the side sheets are turned under on top of the side sills and riveted through the top flange. A car somewhat similar is the one built for the Michigan Central by the American Car & Foundry Company and intended for coal shipments. This, however, has an entirely different hopper arrangement, the sides of the car being brought inside the side sills and the load discharged vertically from the hoppers. The hopper doors are hung on two links and may be withdrawn horizontally from under the hopper by means of a door shaft at each end of the car. In this design the side sheets are trussed with vertical and diagonal angles to assist in carrying the load, and the extension of the body bolster up to the hopper slope is of much lighter construction than the pressed steel bolsters used on the Pressed Steel Car Company's design. A hopper car for the Chesapeake & Ohio, built by the Standard Steel Car Company, has still a different arrangement, there being three drop doors in the hopper. This design is very similar to that for the Lehigh Valley, by the same company, so far as bracing the overhang of the hopper and the side sheets.

In the ore districts of the northern peninsula of Michigan a modified design of the ordinary hopper car has been developed for carrying ore only. One of these cars, built by the American Car & Foundry Company for the Great Northern, is shown. This car is much shorter than the standard hopper car and has a much steeper incline to the floor, in order to discharge the load more freely. Cars similar in general appearance to the one shown, which is built of structural shapes, have been built of pressed steel with practically the same modifications in design by the builders, as those mentioned.

In the design of gondola cars, either with or without drop bottoms or double hoppers, there is little difference between existing practice in wooden cars and that used in steel cars. The general practice is to use rolled or pressed channels or I-beams for the sills and to substitute plates for side planks, riveting pressed stakes directly to the sills, instead of using stake pockets. The majority of gondola cars use sills of uniform cross section, but an exception to this rule may be found in the low gondola built by the Standard Steel Car Company for the Lehigh Valley, in which the side sills are slightly deeper at the center than at the ends but in which the center sills are decidedly deeper in the center than at the ends. The Vandalia Line car, built by the Pressed Steel Car Company, has steel sides and floor but wooden drop ends, which is rather a unique feature. A combination of wood and steel for a gondola car is shown in the Norfolk & Western car built by the American Car & Foundry Company, in which a structural steel underframe is used with wooden side and end planks trussed with channels, to carry part of the load. The Pennsylvania Gondola, built by the Pressed Steel Car Company, has a pressed steel underframe with fish belly girder sills and wooden sides, which, however, are not intended to carry any of the load. The two flat cars shown, both of pressed steel, differ somewhat in details of design, although both use the same form of sill. The B. & O. car, built by the American Car & Foundry Company, uses a very deep side sill. The Northern Pacific car, built by the Standard Steel Car Company, has a capacity of 80,000 lbs., as against 100,000 lbs. for the B. & O. car, and the sills are not so deep or so heavy. The sill proper, on the Northern Pacific car, is made from a channel of uniform cross section, and between the bolsters a reinforcing plate is riveted on the outside, giving the sill much the same appearance and practically the same strength, in proportion to the load carried, as the one piece sill used on the B. & O. car.

Drop Bottom Gondola Car for the Norfolk & Western.
Built by the American Car & Foundry Co.



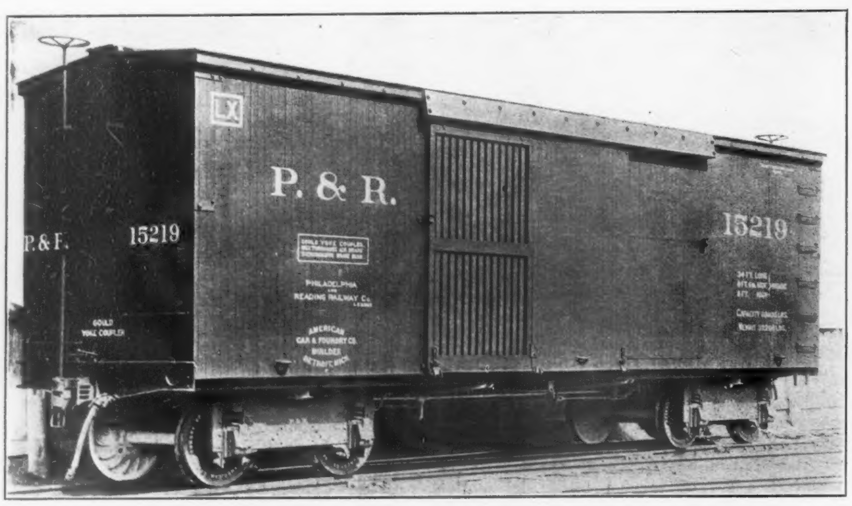
Flat Car for the Northern Pacific.
Built by the Standard Steel Car Co.

Hopper Car for the Michigan Central.
Built by the American Car & Foundry Co.

Pressed Steel Underframe Gondola Car for the Pennsylvania.
Built by the Pressed Steel Car Co.

The use of steel underframes for box and stock cars is becoming more and more common. The car for the New York, Philadelphia & Norfolk, built by the Pressed Steel Car Company, shows the general type of box car with pressed steel underframe. The Philadelphia & Reading car, built by the American Car & Foundry Company, shows a car of somewhat less capacity with a structural steel underframe and cast steel end sills. These cars differ very slightly, so far as under body is concerned, from designs of flat cars of similar capacity. The side frame of the car body is not designed to carry any large proportion of the load.

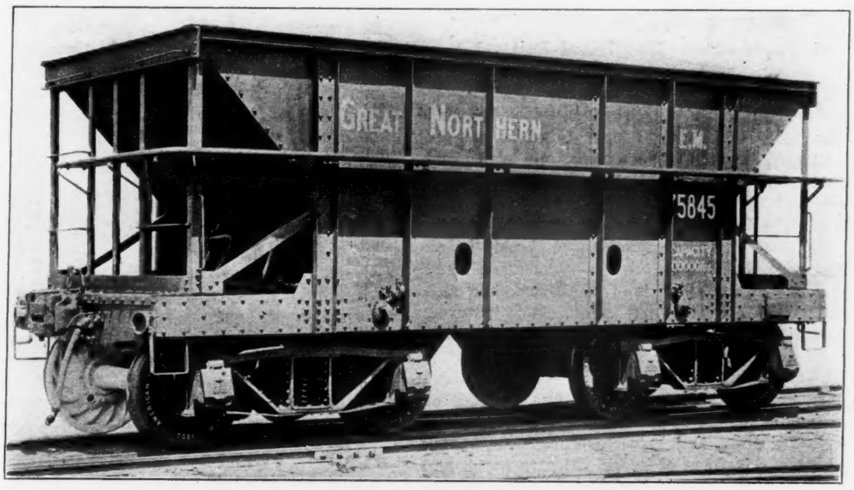
Special service cars have been built, in large numbers, of steel, and one or two characteristic ones are shown. One of these is a narrow gage hopper car with double hoppers, built by the American Car & Foundry Company for the Cananea Consolidated Copper Company. This car has a capacity of 30,000 lbs. and weighs 15,300 lbs. It is a modified form of the standard design of hopper car



Structural Steel Underframe Box Car for the Philadelphia & Reading.
Built by the American Car & Foundry Co.

by the same company, and is given to show the wide field for the steel car. The side dump car for the El Paso & South Western, built by the Pressed Steel Car Company, is designed to discharge the entire load outside the rails. The floor slopes both ways, from the center of the car and the sides are divided into six doors which swing out. The tank car for the Southern Pacific, which is shown, was built by the Standard Steel Car Company and has a capacity of 12,000 gallons or 100,000 lbs. It weighs 51,900 lbs. and is 40 ft. long. The same method of building up the side sills as noted in the Northern Pacific float cars is here used. The tank is carried on seven saddles, which extend clear across the car, and is prevented from moving longitudinally by strap rods, riveted to the side sills at the center and passing around each end of the tank. It will be noted of all of these cars that they are of high capacity, a very large majority of them carrying 100,000 lbs. and designed to stand an overload of ten per cent. without damage. In service, even this figure is often exceeded without serious results.

The tare weight of the cars, of course, varies with the design, but broadly speaking it may be taken as being about 38,000 lbs. for a 100,000-lb. gondola and 40,000 lbs. for a hopper car of equal capacity. For an 80,000-lb. car the tare weight is some 5,000 lbs. less for each type, due largely to the difference in the weight of the trucks. Box cars of 80,000 lbs. capacity weigh about 43,000 lbs., although in many instances this figure is much less. Flat cars weigh from 30,000 lbs. for the 80,000 lb. car to 40,000 lbs. for the 100,000 lb. car, depending on the length and nature of the design.



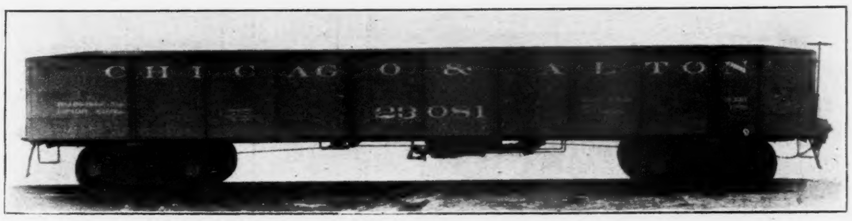
Hopper Ore Car for the Great Northern.
Built by the American Car & Foundry Co.

Drop Bottom Gondola Car for the Erie.
Built by the Standard Steel Car Co.

A New Safety Explosive.*

Since the days of Nobel's invention of dynamite, his mixture, or a close approximation to it, has been used in practically all industrial work requiring the use of a high explosive, until very recent years.

For some 10 or 15 years in Europe, and two or three in this country, there have been coming into use some explosive compounds of the nitro-substitution class, so-called, which are claimed to have advantages over the dynamites, from the standpoints of non-freezability, safety in handling, and certain other points, varying with the particular compound.



Gondola Car for the Chicago & Alton.
Built by the Standard Steel Car Co.

In the summer of 1900, while on the New York Division of the Erie Railroad, the writer had occasion to recommend for trial an explosive having picric acid and sodium nitrate for the principal constituents, and which was advertised to be rather higher in power than 40 per cent. dynamite. There had recently been an explosion of dynamite in storage, for which no definite cause was discovered, and which was rather expensive; moreover, the 40 per cent. dynamite was thought to be a little weak for the rock to be handled, which was a hard metamorphic rock, called by the natives "bastard trap."

A box of this material, known as Joveite, was ordered, and careful tests made under the supervision of the writer, the results of which, with some supplementary ones which he made later, were as follows:

The material is a yellow powder, resembling corn meal, put up in cartridges similar to those of dynamite in size and shape. A quantity of the powder was placed on a rail and hammered with a sledge without result until after several trials a spark was struck, and the powder remaining on the rail burned up with about the rapidity of celluloid.

A stick was then fired into with a shot-gun without result, and then small quantities of equal bulk of Joveite and 40 per cent. dynamite were detonated on the corners of a wrought iron plate, with a view to determine the intensity of explosion. The indication from two trials was that dynamite was a little the quicker. Several trials were made by mudcapping, in comparison with 40 per cent. dynamite, and no difference in the results detected. The powder was then used in the rock itself, and gave results practically identical, as far as work was concerned, with those from dynamite. Its general use was then recommended, and has been continued up to the present.

Joveite is somewhat lighter, bulk for bulk, than dynamite, the proportion being 2 to 3, and it was found that it would do just about the same amount of execution in the rock, bulk for bulk. This made the cost the same, or a little less, the price per pound being 11 or 12 cents. The material is a dry powder and therefore will not freeze. It has been used in the coldest weather without noticeable variation in strength or sensitiveness, and, as far as the writer knows, has never exploded accidentally.

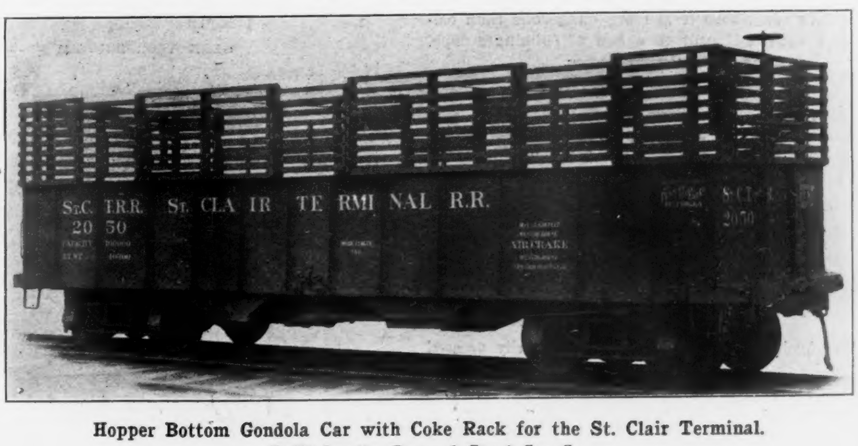
As soon as the men became familiar with the material they began to take liberties with it, such as tamping it heavily in the hole. This gave rise to trouble, in the first few months of its use, for the cartridge in which it was put up was made of paper and frequently burst under this treatment, with the result that the powder was not properly confined in the hole and there were a number of cases of imperfect detonation. The powder is not easily detonated when wet, and, loaded in wet holes, its use was very unsatisfactory, dynamite being substituted; but, recently, the manufacturers have devised a water-tight cartridge with a cloth fiber, which admits of considerable tamping and distortion without becoming pervious. Loaded in this manner, its use is eminently satisfactory.

The detonation is accomplished in the ordinary manner, by the use of a single-strength fulminate-of-mercury cap, either with a powder fuse or fired from a battery. In firing with a fuse, some trouble was experienced occasionally, from the fact that the material is inflammable. When the cap was inserted too far into the cartridge, the fire from the fuse itself would sometimes be communicated to the powder before the primer was fired, which resulted in a "flower pot." This was obviated by the use of electric fuses, or, on the other hand, by a little care in the setting of the powder fuse. It is to be regretted that in many cases owners of quarries still use the old Bickford type of fuse.

In the spring following the disastrous dynamite explosion at 42nd street, in New York City, the manufacturers of Joveite held a public exhibition of their product, at which they ignited a pile of boxes containing 600 lbs. of the explosive. The exhibitors said that their only feeling of nervousness was lest by some faint chance a mercury primer might have got among the boxes. The crowd stood about 80 yds. from the boxes, and it must be confessed that while the mass was taking fire the situation was decidedly interesting. About 150 or 200 lbs. of the explosive burned up immediately, scorching and charring the remaining boxes, which had not been broken open. These were then broken open and lighted, when the mass blazed up and was entirely consumed, with the evolution of a dense white smoke, and no very noticeable odor. Another interesting demonstration was that of dropping a 200-lb. weight upon a box of the explosive in which were scattered bits of iron, nails, etc., resting on an anvil. The fall was about 30 ft., producing sufficient heat of friction and impact to ignite the powder.

A very important point, which the writer does not think has yet been established definitely, is whether this explosive can be made to detonate without flame. It is claimed, by the manufacturers of a rival powder, that their product is absolutely flameless, and can be used safely in mine workings where there is a large quantity of dust, fire damp, etc., in the air. The manufacturers of Joveite say that, under special conditions, where a perfect detonation can be effected, they think that there is no flame from their product. In a mine, under service conditions, they do not claim entire immunity from flame. It has not yet been demonstrated, to the writer's satisfaction, that any explosion accompanied by evolution of heat is not, under some conditions, likely to be also accompanied by flame. Moreover, the question is still open whether fire damp or mine dust, with a proper admixture of gases, may not be detonated by shock. In the writer's opinion, the most instructive experiments with Joveite were witnessed by him at the company's laboratory in March, 1903.

Two sticks of the material were placed on the ground, end to end, the adjacent ends being about 3 in. apart, and one stick only detonated. Afterward, the other stick



Hopper Bottom Gondola Car with Coke Rack for the St. Clair Terminal.
Built by the Pressed Steel Car Co.

*Extracts from a paper read before the American Society of Civil Engineers, June 3, by Richard T. Dana. Vol. 29, page 408, Proceedings.

was detonated by itself. Two sticks were placed side by side, 4 in. apart, and one detonated without detonating the other. A stick was placed on the ground, and a mercury fulminate cap of single strength was fired ½ in. from and pointed at the center of the stick. The blast from the cap tore open the cartridge and threw out some of the powder without detonating it.

A quantity of the powder was sprinkled upon a red-hot iron plate. As the particles touched the plate they flashed into flame with a sputtering, or burned quietly until consumed.

A small quantity of the powder was placed in a small glass tube which was in turn inserted into the middle of another tube and placed between the poles of an extremely powerful spark machine. The machine was easily capable of generating a continuous spark 14 in. long, and was so powerful that it could not be operated for more than a few seconds at a time without burning out the heavy rubber insulation from the copper wires. When the spark was generated, it perforated the smaller glass tube, about 1½ in. in length, longitudinally. The effect of the spark on the explosive was to fuse it and burst the tube. Most of the Joveite was burned, and none of it detonated.

A description of the process of manufacture of Joveite, kindly furnished by Mr. Frank P. Harris, chemist of the company, is as follows:

The powder is composed of a mixture of nitro-naphthalenes, nitrophenols, and a metallic nitrate.

The proportions are as follows:

	No. 1.	No. 2.	No. 3.
Nitro-naphthalenes	9	10	8
Nitro-phenols	14	24	30
Metallic nitrate	77	66	62

Picric acid is used for the nitro-phenol, and is what gives the powder its yellow color. It should be noted, in passing, that this substance stains the hands of the workmen using it. The stains are almost impossible to avoid in using, unless the whole sticks, paraffined, are used, and are exceedingly difficult to remove with the ordinary materials at the workman's command. The yellow stains are not easily visible by artificial light. Picric acid is soluble in alcohol and ether.

The metallic nitrate is dried thoroughly by means of a rotating-drum dryer, screened, and conveyed to a steam-heated room to be kept from absorbing moisture. The nitro-naphthalenes are first melted in a steam-jacketed kettle and stirred by paddle arms, at the temperature of boiling water. Then the nitro-phenols are put in and melted, and, finally, the metallic nitrate, in the form of a dry powder, is stirred thoroughly with the other ingredients. After a time allowed for thorough mixing, the powder is removed to mechanical screens and there granulated to a free-running powder.

By using the nitro-naphthalenes in this way it is possible to melt the nitro-phenols at a safe temperature, while the presence of nitro-naphthalenes in the finished product renders it quite insensitive to shock. By coating the grains of the metallic nitrates with the mixture of the nitro ingredients, the nitrates become protected from the atmosphere as by a varnish, for, while the nitro-phenols are slightly soluble in water, they are not deliquescent. The quality of the powder depends wholly on the purity of the ingredients and the intimacy with which they are mixed.

The cost of detonating Joveite is the same as that for dynamite, the same primer being used. A point which is not yet generally appreciated by workmen is that Joveite and dynamite, through improper setting, will not always detonate as they should, and, as a result, much labor and money are wasted. The point of setting the sticks in contact and, as nearly as possible, entirely filling the hole, with the maximum safe amount of tamping, is often lost sight of. In the tamping, Joveite has a great advantage, as it may be tamped heavily.

The range of practicable application for the "safety explosives" is large. The writer is informed that Joveite has been used successfully to break up frozen iron ore on the cars, an application probably quite beyond the reach of dynamite. It may be transported long distances readily, and used for such purposes as digging post-holes in frozen ground. It should not be difficult to apply it to the driving of piles, the loosening of frozen earth and similar work. The cost of transportation and storage of the safety explosives should be much less than with dynamite. In a railroad collision, Joveite will presumably, at the most, burn up. In storage or transportation it is difficult to see where it is more dangerous than celluloid, except when adjacent to a box of fulminate caps.

A Paving Block for T Rails.

The illustrations show a paving block intended for use with the T rail, in city streets. The block was invented and patented by W. H. Arthur, Superintendent of Public

Works, Stamford, Conn., and is made of specially pressed brick. The brick fits close under the head of the rail, and the ridges are intended to assist carriage wheels out of the groove, and also to make the riding uneven, so that the street car track will become less popular as a place for driving. With a block of this shape, it is thought that T rails can be used in place of grooved girder rails. The Stamford Street Ry. Co. has ordered these blocks for use on its line between Stamford and Greenwich, Conn.

Chemistry of Coal.

Prof. S. W. Parr, of the University of Illinois, has devised a method for determining the amount of sulphur in coal. As the coals of Illinois contain from one to five per cent. of sulphur, and that element indicates the amount of clinker, this new process may be valuable. Prof. Parr has also discovered a means of arriving at the total amount of carbon in coal and other combustibles, a matter of importance to engineers, who need to know how much energy a given fuel ought to yield. The calorimeter which Prof. Parr invented is used in the mines, factories and technical schools of this country and in foreign countries.

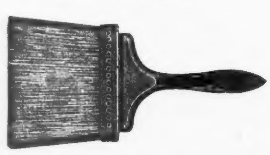
Brush Specifications, Long Island Railroad.

Somewhat more than 25 years ago Col. Balch made for the receiver of the Erie Railroad a "true, full and complete" inventory of its possessions. The list covered 12,000 folio pages, bound in 19 volumes, and was probably the first graphic picture of the extent and variety of materials used by railroads in their vast and minute housekeeping. The items seem to cover most known raw materials and manufactured articles. A brush is an humble implement, but a good one does good work and a poor one does bad work. It is of small cost, but such enormous quantities are used that great cost is involved. It is the multiplicand, not the multiplier, that makes the few cents difference in the single price important.

Mr. H. B. Hodges, purchasing agent of the Long Island Railroad, has printed the specifications for brushes, for the preparation of which he wants credit given to Mr. C. N. Forrest, chemist and inspector for the company. So far as known this form of specification is novel, and it is therefore reprinted nearly in full:

Manufacturers in furnishing brushes, must confine themselves to the designs and dimensions given in these specifications, and must mark on the handle of each brush the "L. I. number" as well as such other marks as they are accustomed to put on their brushes. The general workmanship, finish and quality of all brushes must be the same as the standard samples on file in the purchasing agent's office. All bristles and hair used must be thoroughly cleaned, and of the best quality and grade of their class. No pegs, cement, wedges or filling of any kind, not strictly and necessarily a portion of the system of fastening, must be used. All bristles must have not less than $^{15}/_{32}$ of an inch hold in the ferrule or other material in which they are set, and must not shed in service.

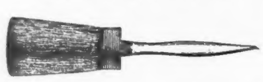
FLAT WALL BRUSH.



Best quality stiff, unbleached, Russian bristles, set with cement, bound with leather and nailed.

Style. In.	Block inside brush. In.	Width brush inside ferrule. In.	Thickness brush inside ferrule. In.	Length bristles outside ferrule. In.	Wgt. bristles in brush. Oz.
5	⅝ x 4 7/16	4 15/16	1 11/16	4	6¾
3	9/16 x 2 7/16	2 11/16	1½	4	3½

ROUND PAINT BRUSH.



Best quality, stiff all white Russian bristles, set with cement. Wire ferrule.

Diameter handle inside brush. In.	Diam. bristles inside ferrule. In.	Length bristles outside ferrule In.	Wgt. bristles in brush. Oz.
1	2	5½	6
1	1 15/16	5	5⅝

SASH TOOL BRUSH.

Best quality white French or German bristles, boiled and straightened. Bristles set with cement and bound with twine.

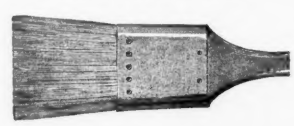
Style.	Diam. bristles inside ferrule. In.	Length bristles outside ferrule. In.
Round	1 1/16	3⅛
Round	1	3

FLAT FITCHES.

Best quality white French or German bristles, boiled and straightened. Bristles set with cement, bound with tinned metal and nailed. Ferrule to be securely soldered at the lap, and fastened to handle.

Style. In.	Width bristles inside ferrule. In.	Thickness bristles inside ferrule. In.	Length bristles outside ferrule. In.
2	1 15/16	9/16	2⅜
1½	1 7/16	⅜	2
1	15/16	5/16	1 9/16
½	7/16	¼	1

FLAT PAINT BRUSH.



Best quality white French or German bristles, set with cement and nailed. Ferrule to be tinned metal, securely soldered at the lap and fastened to the handle. Style, 2 in.; width of bristles inside of ferrule, 1⅞ in.; thickness of bristles inside of ferrule, ½ in.; length of bristles outside of ferrule, 2¼ in.

OVAL CHISELED VARNISH BRUSH.

Best quality white French or German bristles, boiled and straightened, and set with cement. Bristles to be laid to form a chisel and the flag ends must not be cut. Ferrule to be of seamless metal.

Width bristles inside ferrule. In.	Thickness bristles inside ferrule. In.	Length bristles outside ferrule. In.	Size handle inside brush. In.
2	1⅝	3¾	½ x 1 13/16
Thumb brush for car shops only.			
1 15/16	1⅝	3⅜	⅝ x 1⅛

FLAT CHISELED VARNISH BRUSH.

Fine unbleached French or German bristles, boiled and straightened. Bristles to be set with glue and nailed. Ferrules to be polished brass securely soldered at the lap, and nailed to the handle.

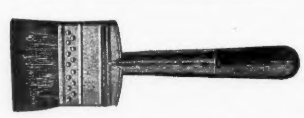
Style. In.	Width bristles. inside ferrule. In.	Thickness bristles inside ferrule. In.	Length bristles outside ferrule. In.
3	2 15/16	¾	2¾
2½	2 7/16	¾	2⅝
2	1 15/16	⅝	2 5/16
1½	1 7/16	9/16	2⅛
1½	Thumb brush for car shops only.		

CAMEL'S HAIR COLOR BRUSH.

Best quality of squirrel-tail hair, set with glue and double nailed. Ferrules to be polished brass, securely soldered at the lap, and nailed to the handle.

Style. In.	Width hair inside ferrule. In.	Thickness hair inside ferrule. In.	Length hair outside ferrule. In.
3	3	9/16	1¾
2½	2½	½	1½
2	2	½	1 7/16
1½	1½	7/16	1⅜
1	1	⅜	1⅛
½	½	5/16	1

BLACK SABLE VARNISH BRUSH.



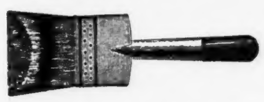
Best quality genuine black sable hair, set with glue and nailed. Ferrules to be nickel plated and securely fastened at all joints. Style, 2 in.; width of hair inside of ferrule, $1^{15}/_{16}$ in.; thickness of hair inside of ferrule, $^{15}/_{32}$ in.; length of hair outside of ferrule, 1⅜ in.

STENCIL BRUSH.

Best quality, grey German bristles. Ferrules to be of seamless metal securely fastened to the handles. Bristles to be secured by metal plug in center of brush.

Inside diameter of ferrule. In.	Length bristles outside ferrule. In.	Diameter of metal plug in center of brush. In.
1⅞	1½	1
11/16	1	⅝

BADGER FLOWING BRUSH.

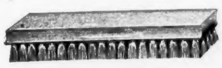


Best quality German or Russian badger hair of uniform color, set with glue and double nailed, and laid so as to form a chiseled edge. Ferrules to be nickel plated and securely fastened at all joints. Style, 2 in.; width of hair inside of ferrule, $1\frac{15}{16}$ in.; thickness of hair inside of ferrule, $\frac{9}{16}$ in.; length of hair outside of ferrule, 1¾ in.

ROUND SCRUB BRUSH.

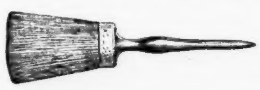
Best quality, stiff grey Russian bristles, set with cement. Ferrules to be seamless metal, with solid metal back. Diameter of handle inside of brush, 1 in.; diameter of bristles inside of ferrule, $1\frac{13}{16}$ in.; length of bristles outside of ferrule, 2¼ in.

FLAT SCRUB BRUSH.



Number 31 to be made of stiff grey Russian bristles. Number 32 to be made of fiber. All knots to be bound with thread and set with cement. Size of block, 8 in. x 3¾ in.; rows of knots in brush, 5; number of knots in brush, 70; diameter of knots, ¼ in.; length of bristles, 1⅛ in.

ROUND PAINTER'S DUSTER.



Best quality Russian bristles, unbleached outside and grey center. Bristles to be set with cement, each knot to be securely bound with thread and the end of thread brought under and across, butt end of knot as it is set in the block. Holes to be at least $\frac{15}{32}$ in. deep. Diameter of block, $2\frac{7}{16}$; diameter of knots, outside row, $\frac{3}{16}$ in.; center rows, $\frac{9}{32}$ in.; knots in outside row, 24; knots in brush, 40; length of bristles outside of block, 3¾ in.

COUNTER DUSTER.

Best quality of grey Russian or German bristles throughout. Bristles to be set with cement and each knot securely bound with thread, and the end of thread brought under and across, butt end of knot as it is set in the block. Holes to be not less than $\frac{15}{32}$ in. deep. Diameter of knots in brush, outside, $\frac{3}{16}$ in.; center, ¼ in.; length of bristles outside of block, 3 in.; length of bristle part of brush, 9 in.; total length of brush, 15 in.; number of knots in brush, outside 34, center 24.

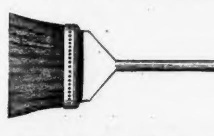
FLOOR SWEEPING BRUSH.

Best quality grey Russian bristles throughout. Bristles to be set with cement, and the end of each knot bound with thread, and the end of thread brought under and across, butt end of knot as it is set in the block. Holes in block to be not less than $\frac{15}{32}$ in. deep. Block to have to staff holes, tapped with screw thread at the proper angle. A handle 54 in. long, with smooth polished surface, and screw thread at one end to fit holes in block is to be furnished with each brush. Diameter of knots in brush, outside, $\frac{3}{16}$ in.; center, ¼ in.; number of knots in brush, outside, 70; center, 54; length of bristles outside of brush, 3¾ in.; length of block, 14 in.

RADIATOR BRUSH.

One row of best quality grey Russian bristles. Each knot to be securely bound with thread, the end of thread to be brought under and across the butt end of knot as it is set in the brush, and set with cement. Diameter of knots in brush, $\frac{3}{16}$ in.; number of knots in brush, 36; length of bristles outside of block, 3½ in.; length of bristle part of block, 9 in.; total length of brush, 22½ in.

WHITE WASH BRUSH.



Best quality, stiff Russian bristles, white outside, grey center. To be bound with leather straps, ¾ in. wide, cut from best grade of 6½ oz. leather, and well secured with flat head brush tacks. Style, 7 in. handle; size of block inside of brush, ½ in. x 6 in.; width of bristles inside ferrule, 7 in.; thickness of bristles inside of ferrule, 1½ in.; length of bristles outside of ferrule, 3¾ in.; length of handle, 13 in.

STOVE BRUSH.

Best quality, stiff grey Russian or German bristles throughout. Bristles to be fastened with copper wire, and holes to be well filled. Handle to be securely fastened to the brush with screws. Size of block, 9 in.; number of knots in brush, 160; diameter of holes for knots, 19 B. & S. wire gage; length of bristles outside of block, 1¼ in.

CAR WASHER.

Best quality, grey Russian bristles throughout. Bristles to be securely fastened by copper wire. The two portions of the block to be securely fastened together by 1½ in. screws, and must not warp apart. Block to be provided with suitable holes for handle, and bound with a rubber buffer. Diameter of block, 5¼ in.; diameter of knots, outside, $\frac{3}{16}$ in.; center, $\frac{3}{16}$ in.; number of knots in brush, outside, 43; center, 126; length of bristles outside of block, 3¾ in.

A New All-Metal Passenger Truck.

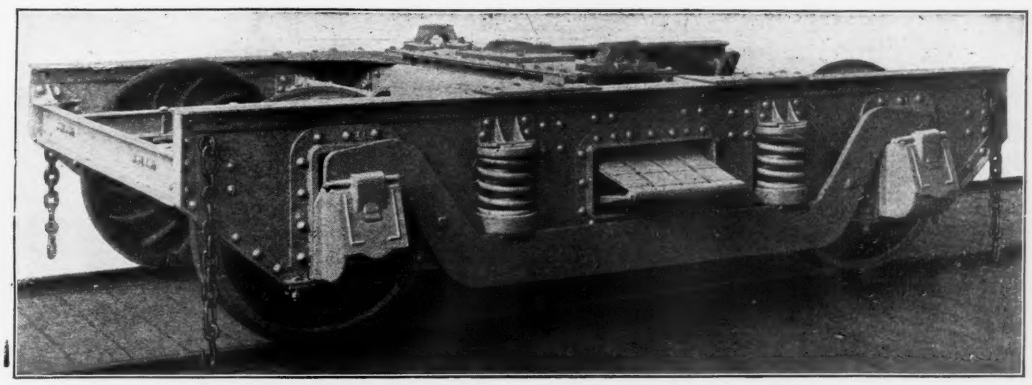
The all-metal passenger car truck shown in the engraving is built by the Barney & Smith Car Co., and is designed to meet the requirements of heavy modern passenger equipment. The principal dimensions are:

Wheel-base	8 ft. 0 in.
Width over side frames	6 ft. 9 in.
Length of side frames	11 ft. 10 in.
Wheels	33 in. or 36 in.
Axles	Steel, M. C. B. 80,000 lbs.
Bolster springs	36-in. quadruple elliptic
Equalizer springs	3 coils, 8 in. x 10 in.
Brake rigging	Inside hung
Weight per set of two trucks with 36-in. steel-tired wheels	27,800 lbs.

The side frames are composed of ¾-in. steel plates cut out for the oil boxes and the equalizer and bolster springs, and reinforced all around by angle irons. The pedestals and equalizer spring caps are malleable iron, riveted to the side frames. The transoms are made of ⅝-in. steel plates formed to the shape of an inverted box, flanged at each end on each side and secured to the side frames by ¾-in. rivets. On top of the transoms and side frames and riveted to each are steel gusset plates. The end pieces are 6-in. channels riveted to the side frames through malleable-iron brackets. The safety beams are 4-in. I-beams secured to the end pieces and transoms by angles.

The bolster is composed of two 8-in. I-beams with a ½-in. steel cover plate and a ⅜-in. steel bottom plate. Between the I-beams are three malleable-iron fillers, one at the center and one at each end. The center-plates and side-bearings are secured by bolts. The spring plank is composed of two 3 x 4 x ½-in. angles, to which are riveted the bolster spring seats and the swing-motion axle bearings. The equalizers are made of 7 in. x 1⅛ in. steel, and there are four per truck, one inside and one outside of each side frame, the ends, or feet, fitting into grooves on top of the oil boxes.

The truck is 4 in. lower than the standard type of four-wheel wooden truck, which gives more room under the car body for pipes, etc., and also enables the body bolster to be given greater set. A primary object in the development of this design was to obtain simplicity of design and construction. A set of these trucks has been in constant service under a car body weighing 65,000 lbs. for nearly a year, making an average daily mileage of 360 miles, and in this time not a single part has failed or defect developed. The patents for the design are pending.



Metal Passenger Truck—Built by the Barney & Smith Car Co.

Demurrage Managers' Annual Meeting.

The fourteenth annual meeting of the National Association of Car Service [Demurrage] Managers was held in Chicago June 16 and 17. Mr. J. E. Challenger, of Philadelphia, President, opened the meeting with a brief address, felicitating the Association upon the large attendance and upon the improved condition of things.

The Secretary's annual report showed

Cars reported in 1902 by all associations	24,516,614
Cars reported in 1901	19,617,500
Average detention by railroads, 1902	.34 day per car
Average detention by railroads, 1901	.38 day per car
Average detention by the public, 1902	1.32 days per car
Average detention by the public, 1901	1.38 days per car
Total average detention, 1902	1.60 days per car
Total average detention, 1901	1.72 days per car

The vast business of 1902 could not have been handled if cars had been delayed an average of 6.17 days each, as they were prior to the establishment of the rules. The Secretary has no complete data showing the net revenue collected by all of the railroads under car service rules, but many thousands of dollars are left in the treasuries of the railroads after paying all the expenses of the various associations. Between 95 and 96 per cent. of all the cars reported to the various associations are released within the free time allowed by the rules.

Mr. A. W. Sullivan, of the Illinois Central, delivered an address on "Car Service in Its Relations to Operation." This was given in the *Railroad Gazette* last week, page 442. Mr. Sullivan's address met with hearty commendation, and the Secretary was directed to have 5,000 copies printed for distribution by managers. Mr. Charles B. Peck, of the Texas Car Service Association, presented a paper on "The Relation of the Manager to the Railroad Commission."

Storage in Railroad Warehouses elicited much discussion. Mr. C. W. Sanford, Manager of the Chicago Car Service Association, read an interesting paper on warehouse storage rules, showing that they have been successfully applied in Chicago. Mr. Sanford answered a great variety of questions as to the force employed, the forms used, and methods of accounting under storage rules. He demonstrated that his rules have relieved the congestion in warehouses and on team tracks, have decreased the cost of handling package freight, decreased claims for loss and damage, and decreased the many small items of uncollected freight charges. They have also greatly expedited the delivery of warehouse freight when called for. All of this has been accomplished at an expense of from 10 to 15 per cent. of the amount collected for storage beyond the free time allowed. Mr. I. L. Lockwood, Agent of the New York, Chicago & St. Louis at Chicago, argued that an up-to-date freight station could not be properly conducted without warehouse storage and demurrage rules. He said that under them deliveries were taken within the free time, and that the floor space in his warehouse was made available for the distribution of small shipments, so that every consignee could get his freight promptly when called for.

What is known as the average rule came in for a good deal of discussion. It was attacked by many as a surrender of the car-service principle, and as inimical to car service rules. A motion committing the National Association to an unqualified condemnation of the system, was offered, but after some lively argument it was laid upon the table.

On the second day Mr. C. D. Clark, counsel for the Chicago Car Service Association, made an interesting address outlining the legal phases of car service, and suggesting how cases should be prepared for presentation to the courts. The summing up of Mr. Clark's address was that, whenever possible, car service cases should be presented to the court with all matters of fact agreed upon, leaving only points of law to be determined. Later in the same session, Mr. F. A. Delano, General Manager of the Chicago, Burlington & Quincy, addressed the convention. He spoke of the peculiarly difficult position of the car service manager. He must have a high degree of common sense and consideration for the other man. The speaker said that the doctrine that "Might makes Right," should be changed to "Right makes Might"; and that, while the car service manager must be an ardent defender of his client, the railroad, he must, at the same time, be willing to make haste slowly, working out each problem in a spirit of conciliation.

Much of the time of the convention was given up to

informal discussions on car service claims and on office methods. It was the general sentiment that this was the best convention the National Association had ever held. Resolutions of thanks were adopted for the many pleasant features of entertainment provided by Manager Sanford, of the Chicago Association, and similar resolutions were tendered to Mr. Sullivan, Mr. Clark, and Mr. Delano.

It was agreed that the next annual meeting be held at Niagara Falls June 16, 1904. J. C. Loomis, Louisville, Ky., was elected President; A. J. Elliott, Peoria, Ill., Vice-President, and A. G. Thomason, Scranton, Pa., Secretary and Treasurer. J. C. Haskell, of Atlanta, Ga.; A. L. Gardner, of Baltimore, and C. W. Sanford, of Chicago, were elected members of the Executive Committee.

Steel Coke Cars for the Pennsylvania Lines West.

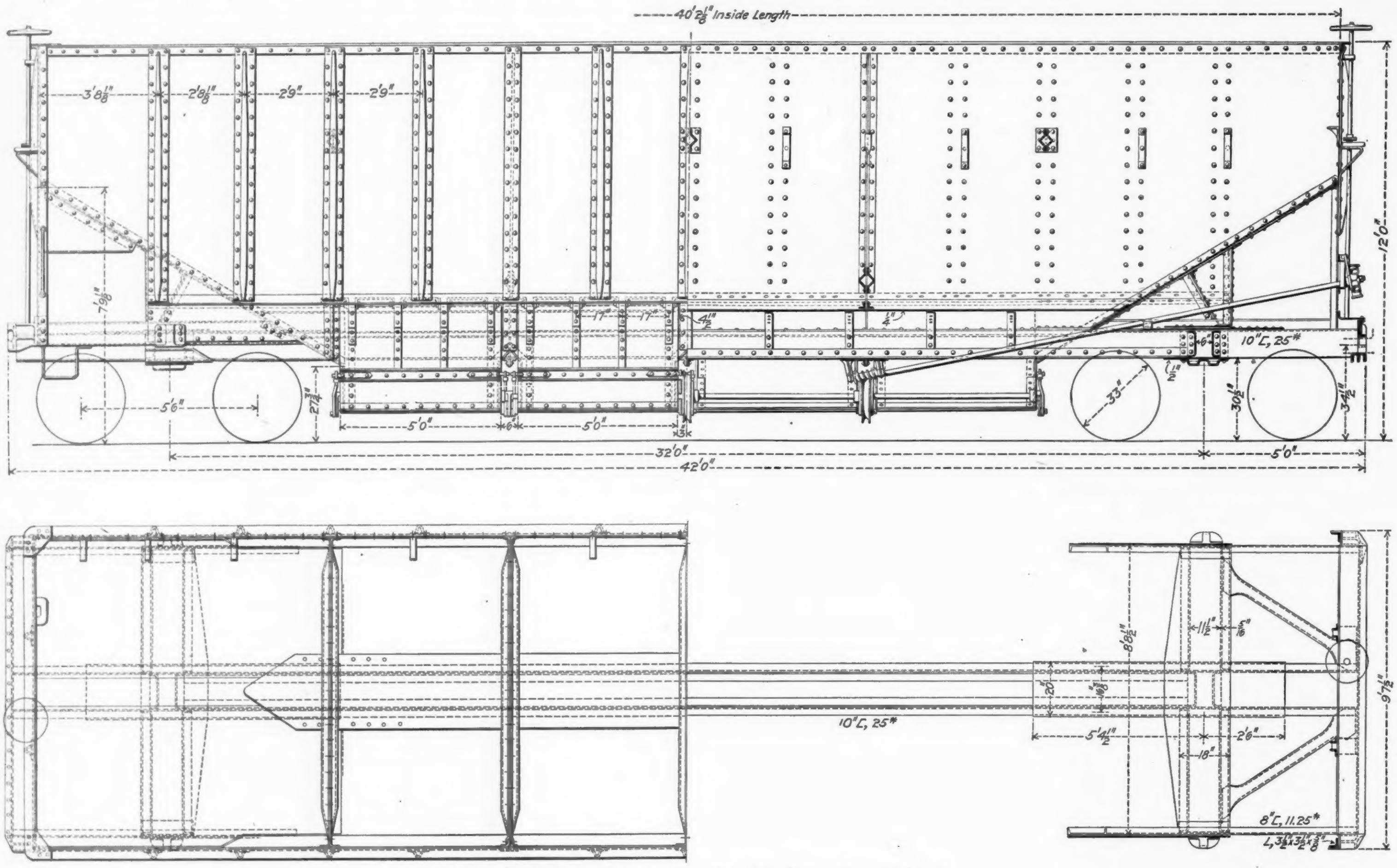
The most striking feature of modern car design is the constant tendency toward special cars for special service. The car shown in the accompanying illustrations is a good example of this tendency. It is an all-steel car of 100,000 lbs. capacity, designed by the railroad company to haul coke from the coke regions near Pittsburg to the blast furnaces nearby. Much attention has been paid to the loading and unloading arrangements at the lake ports and steel works with a view to effecting economies in the handling of coal and ore, but much less has been done in designing machinery to properly handle coke which is quite as important a material in iron and steel making and much more difficult to load and discharge than the other two. It is comparatively fragile and useless if broken fine. Loading it in racked gondolas or box and stock cars and unloading by hand with shovels is slow and expensive work. With a concentrated load like coal or ore which moves freely the present design of hopper car is not altogether satisfactory and the choking of the hoppers is even more frequent with a light material like coke which does not move freely owing to the rough surfaces and irregular shapes of the pieces.

The Pressed Steel Car Co. has just completed an experimental order of cars and they are now running in service to develop, if possible, any defects in design before being finally approved as standard. In general appearance these cars are similar to the ordinary type of double hopper cars except that the doors are placed on the sides below the sills and open outward. There are four doors on each side 5 ft. long and 3 ft. 3 in. deep, all operated from the same shaft. The floor sheets slope 1 in 1.7 from the ends toward the center, terminating at the ends of the hopper doors. In the middle of the car the floor slopes outward to each side, forming two hoppers divided by partitions into four pockets, which are closed by the doors. These center hopper sheets or discharging aprons are supported by braces riveted under the center sills, and are themselves riveted to the top flange of the sills, a ridge or cover plate being lapped over them. This arrangement gives a large opening for discharging the load, and one in which there is little tendency to choke in passing through the hoppers. The bottom of the aprons is only 11 in. above the rail, which prevents the coke from breaking in unloading and the entire discharge takes place outside the rails.

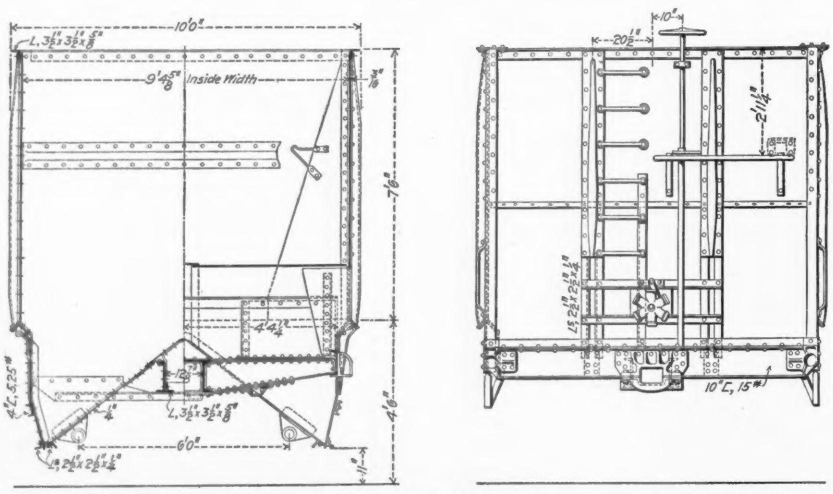
The cars are exceptional in point of size, being 10 ft. longer and 2 ft. higher from plate to rail than the standard hopper cars of the Pennsylvania. Their dimensions are: length inside, 40 ft. 2⅝ in.; width, 9 ft. 4⅝ in.; height from rail, 12 ft. The capacity is approximately 3,000 cu. ft. or 100,000 lbs., assuming coke to weigh 33 lbs. per cu. ft.

Structural shapes have been generally used in the construction. The load is carried on the two center sills, there being no continuous side sills. Each side sheet is re-enforced at the bottom above the doors by a heavy angle with unequal legs and forms a deep plate girder well supported at the bolsters which carries a part of the load. Eight-inch channels, 11.25 lbs. per ft., with flanges inside, are used for side sills and extend from the end sill back over the bolster to the side sheets. The center sills are continuous from end to end and are 10 in. channels, 25 lbs. per ft., spaced 12⅞ in. apart with flanges turned out. A 10 in. channel, 15 lbs. per ft., is used for the end sill with a cover plate riveted to the top flange and running back 9 in. to the end posts, where it is turned up and riveted to all the posts. The bottom flange and part of the web is cut out for the coupler shank and around the opening is riveted a heavy cast-steel striking plate. The coupler carry iron is bolted through the bottom flange of the end sill and lugs on the striking plate. It is also cast-steel.

The body bolster is built up around the center sills and is made of pressed steel channels with flanges out placed 11½ in. apart and heavily tied together with top and bottom cover plates. Diagonal braces extend from the end sill at the center to the outer ends of the bolster. The overhang of the hopper floor is supported over the bolster by a re-enforced vertical plate and a similar strut normal to the hopper floor. Angles, 2½ in. x 2½ in. x ¼ in. are used for end posts and similar shapes 3½ in. x 3½ in. x ⅝ in. for corner posts. This gives a design for the end framing of the car of great strength and stiffness. The side and end sheets are stiffened along the top edge with angles 3½ in. x 3½ in. x ⅝ in., and five cross ties in the center of the car, three well up and two just above the doors prevent bulging of the sides.



Plan and Elevation—Class Gt. Coke Car—Pennsylvania Lines.



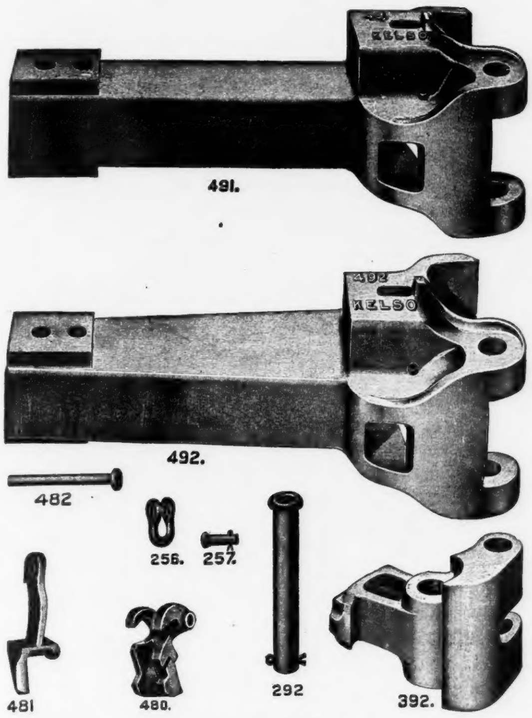
Cross Section and End Elevation—Class Gt. Coke Car—Pennsylvania Lines.

The operating mechanism of the doors is very simple. Each door is swung independently of the rest from four strap hinges hung on brackets fastened to the angle which runs along the bottom edge of the side sheets. At both ends of each door are a pair of links fastened to the operating shaft, which is carried in brackets riveted to the discharging apron, one shaft on each side of the car. These links are fastened to a 4 in., 5.25 lb. channel, which is riveted along the outside of the door about 13 in. from the bottom edge and they work in the recesses formed by the double partitions in the hopper. At one end of the car in the center line and well above the end sill is a six-arm capstan supported in a bracket fastened to two cross bars between the end posts. This capstan turns a heavy shaft which slopes downward, between the center sills to the partition between the first and second doors. At this end is a chain worm around which is wrapped a chain running around the sheaves on the door shafts on both sides of the car. By turning the capstan the chain is wound off the sheaves and revolves the door shafts, opening or closing the doors through the links. To keep the movement of the doors together another pair of sheaves is mounted on the operating shafts between the two center doors and a crossed chain wound over them. The proportions of the links make the doors self locking when once closed. The bottom edges of both the doors and aprons are stiffened with 2½ angles.

We are indebted to Mr. A. W. Gibbs, General Superintendent of Motive Power of the Pennsylvania, for the drawings.

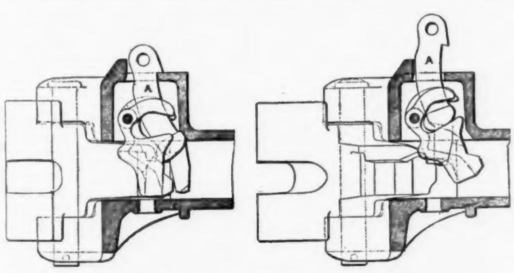
The Kelso Coupler.

The first conception of the present M. C. B. type of vertical plane automatic coupler was to provide a means for automatically coupling cars by impact. The early forms of couplers performed this function, and this did away with one source of danger, perhaps the most important one—that of making the men go between the cars to hold up a loose link to make the coupling. There are other times, however, when the men must place themselves in a dangerous position, and to avoid the necessity



The Kelso Coupler.

of doing this the more modern forms of couplers have been designed to perform two other functions automatically; that of opening the knuckle and of setting the lock for uncoupling before the cars are parted. The first, or automatic lock feature, is, of course, the most important, and of the other two, which are found either singly or in combination in modern couplers, the lock-set is perhaps the most desirable feature, since it is a part of the mechanism which is used every time the coupler is operated. It automatically accomplishes the same function which the shelf brackets for the uncoupling lever do, and saves the trainmen much time and labor in making up and in cutting long trains. With a coupler not provided with a lockset the trainmen must run alongside of the car and hold up the uncoupling lever while the cars are being parted. In crowded yards, and especially at night, this subjects the men to much danger from falling over switch targets or similar obstructions between the tracks. With the lock-set feature the trainmen can uncouple the cars at any



Knuckle closed and locked. Knuckle open and unlocked.

The Kelso Coupler.

point in the train and when the cars are parted the lock falls again to its normal position with the opening of the knuckle. To couple up again, no further attention from the trainmen is required, since the knuckle is open and the lock in position to fall in front of the knuckle when the cars come together.

The accompanying engravings show the Kelso coupler made by the McConway & Torley Company, Pittsburg, which has been designed to meet the severe conditions of service now found with the high capacity car. This coupler combines all of the good points of the pioneer Janney coupler, made by the same company, and has the additional feature of an efficient lock-set. Several thousand cars have been equipped within the last three years with these couplers and they are giving excellent service. They are made in two sizes, a 5 in. x 5 in. shank and a 5 in. x 7 in. shank, from open hearth steel. The parts of the operating mechanism, also shown in the engraving, are common to both. The lock-set is positive in its operation and cannot be shaken down by a slight movement of the knuckle due to the recoil of the draft springs when the cars run together, or by the oscillation of the cars in passing over frogs and switches. The lock is not set in a position for coupling on impact until the knuckle has opened 80 per cent. of its range of movement, which is only possible when the cars part. The same member which acts as a lock-set in the uncoupling position also acts as a lock to the lock in the coupling position, preventing any creeping of the lock and consequent opening of the knuckle. Many unexplained break-in-twos of trains are doubtless caused by the lock creeping and the knuckle opening when released. A positive lock to the lock, such as this, effectually prevents break-in-twos from such a cause. The positions of the parts, both in the locked and unlocked position, are shown in the smaller drawing.

Peckham Steel Passenger Car Truck.

The steel truck having supplanted the wooden truck for freight car work is now being put under passenger cars of the steam railroads and it is probable that, in the course of a few years, it will be the standard method of construction in this field as it already is in street railroad service.

The Peckham Manufacturing Co., Kingston, N. Y., has designed and built two trial trucks for the Central Railroad of New Jersey, one of which is exhibited at Saratoga this week. In general appearance it follows the lines of the truck for electric cars exhibited a year ago, and which was built for the Chicago, Elgin & Aurora R. R., where speeds of 60 miles an hour are attained. The new truck, however, was not hampered by the limitations of wheel base as in the case of the Aurora trucks, and follows the standard practice of the road for which it was built. It follows the dimensions and standards of the Central truck in all parts, has the same wheel base of 8 ft.; uses the same equalizer and elliptic springs, journal boxes, wheels, axles, center plate and brake levers, and holds the car body at the same height above the rails. It weighs complete with wheels and axles 13,370 lbs.

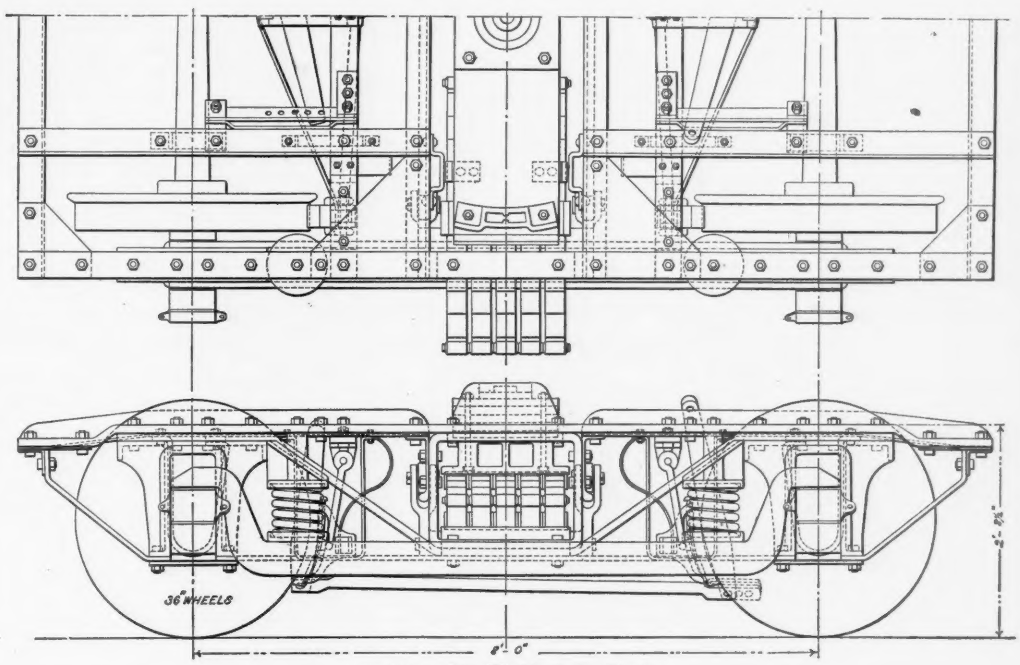
In appearance it is similar to the diamond freight truck, except that it has the equalizers of the passenger car truck, with the same spring arrangement as that used in the wooden truck. The top frame is of 4 in. by 1¼ in. steel, and the archbar is 4 in. by 1⅛ in. The ends are dropped to clear the draft rigging and the cross piece is a 4 in. by 4 in. angle, which is held in place by gussets at the corners.

The transoms are made of 8 in. bulb angles, riveted to the top frame and the column spacer, and are held square by broad gussets riveted to their top flanges and the top frames. The bolster is made in two parts and is 11¼ in. deep, having ample strength. It is 16 in. wide and is 1¼ in. thick in the top or compression member, and 1 in. thick in the lower or tension.

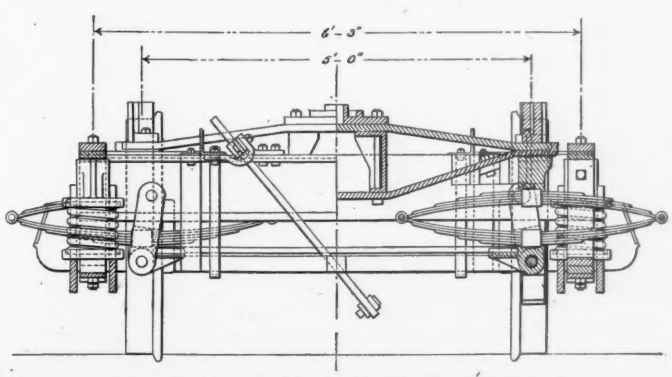
Contrary to the common practice but following that of the road for which it is built the truck is fitted with inside hung brakes carried by a crossbar bolted to the frame and the safety beam, which is a 4 in. angle. This makes a rather long compression bar but no difficulty has been experienced with others of even greater length in service.

In the construction of the truck the standard practice of the builders has been followed. All holes are drilled and the parts are assembled over templates that hold them in true alinement. The holes through all of the assembled parts are then reamed and the fastenings made with finished bolts turned to a driving fit.

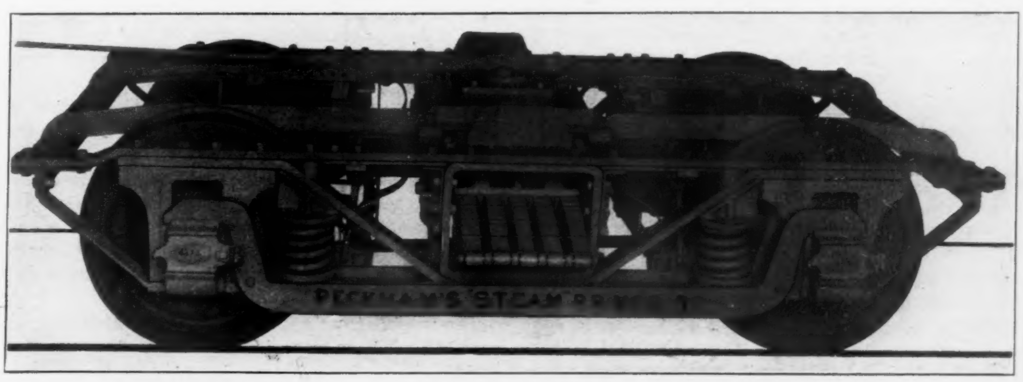
The car which these trucks will carry weighs 65,000 lbs. empty, and is used in both express and local service. The design is simple and all parts are readily accessible for inspection and repairs. It is expected that the riding qualities will be the same as those of the one now in use, and that it will serve to convince the American railroad man that the steel truck is as well suited to passenger as to freight work and that it is as applicable to American as to European cars.



Peckham No. 50, M. C. B. Truck.



Cross-Section, Peckham No. 50, M. C. B. Truck.



Peckham No. 50, M. C. B. Truck.

RAILROAD GAZETTE

ESTABLISHED IN APRIL, 1856.
PUBLISHED EVERY FRIDAY
At 83 Fulton Street, New York.

EDITORIAL ANNOUNCEMENTS.

CONTRIBUTIONS.—Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies in their management, particulars as to the business of the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and railroads, and suggestions as to its improvement. Discussion of subjects pertaining to ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

Progress in Car Building.

The many improvements in freight car construction in late years have mainly tended to increase the carrying capacity, or, rather, the carrying capacity has been arbitrarily increased and the details of its construction necessarily strengthened or redesigned to meet the more severe conditions of service brought about by the heavy car and the long trains now hauled. About six years ago the first cars of 100,000 lbs. capacity were put out in regular service and since that time they have proved their economy over the smaller car. On many roads the tendency is to bring all of their equipment up to something like this capacity. This increase of capacity, first from 40,000 to 60,000 lbs., and then to 80,000 and 90,000 and finally to the 100,000 lb. car, has been made both for economical reasons and because of the demands of the traffic department. Shippers have insisted on consigning their goods in large lots and the traffic department in order to retain the trade, has in turn, demanded cars big enough and strong enough to carry the increased loads. The tremendous increase in traffic within late years over the coal and ore carrying roads to and from the iron districts, has brought about an effort to decrease the cost of transportation to the lowest possible figure and car loads and train loads have been increased, until now the carrying capacity of the cars is severely taxed. The cars made up in the train are computed as closely as possible to the load which the engine can just start. The high capacity car is giving satisfactory service wherever used and the tendency seems to be to use it in every class of service to the exclusion of smaller capacity cars which cannot carry the same revenue load.

Special cars for special service are coming more and more into use. The traffic department having built up a large and steady business for a certain class of freight, it has devolved upon the car department to build cars adapted for economically handling that particular kind of freight. Not long since it was the practice to use a box car or stock car for carrying anything from grain or merchandise to coal or lime, regardless of the possible effect of the different character of the load on the material or construction of the car. Perhaps the most striking example of cars for special service is the development of the steel hopper car for carrying ore from the lake ports to the blast furnace regions further south and carrying coal back to the lake ports. Extensive and costly dock and unloading facilities have been provided at both terminals and the hopper car has been built to conform to the requirements of these terminal points. It is a car designed to carry its maximum load when filled with coal and to utilize only a part of its cubic capacity when loaded with ore. The contents are discharged between the rails by gravity into the loading chutes or stock piles under the trestles. In the iron ore districts a modified form of the steel hopper car has been developed, designed for carrying ore alone, to run loaded to the docks and empty to the mines These cars have the same weight capacity as the cars for coal and ore but less cubic capacity, being shorter and having a steeper hopper slope which discharges the load somewhat more freely than the usual 30 deg. incline. Special cars for carrying coke with a cubic capacity of more than 3,000 cu. ft. and side doors well down near the rail, are now being tried in service. The increase in the use of crude petroleum for fuel has brought about a number of unique and particularly well adapted designs of tank cars to be used in transporting the oil from the wells to the seaboard or to interior points. Most of these have a capacity of 12,000 gals. or 100,000 lbs. and all have steel underframes. Large industrial and manufacturing companies are now having cars built suited to their particular needs for handling material between producer and consumer.

Despite the objections with which it was first met, the use of steel either in the underframing alone or for the entire car body has come to be established and general practice. The steel hopper or gondola car has so many advantages over the wooden one, in weight and strength and durability, that practically all of this class of cars are now made either entirely of steel or of a composite construction of wood and steel such as is used on the Norfolk & Western. Flat cars and box cars with pressed or structural steel underframes and in some instances body framing also are being built in large numbers. On another page is a description of some long passenger coaches with I-beam sills and deck beam cross-ties, building for the Chicago, Indianapolis & Louisville which is a distinct advance in passenger car design. Pressed steel shapes still seem to be the most approved form, although the use of channels, I-beams and other structural shapes for steel underframes or composite underframes is general. Repairing of steel cars is now satisfactorily done by those roads having the most of this class of work to do, and their repairs are no more difficult or costly than similar repairs for wooden cars. The experience of these roads has been that the steel car will stand much more unfair treatment without serious damage than the wooden one.

There has been put upon the market in the last two or three years a great variety of trucks, many of them being modified forms of the familiar diamond arch bar truck. The diamond arch bar type, however, strengthened for the heavy cars, still seems to be the one most used and properly designed, it is quite as strong and cheap as any of the patented trucks. The principal modifications and improvements have been confined to the bolsters. Means for easing the lateral shock on the bolster and sideframes without, strictly speaking, a swing motion, have been applied under a number of heavy cars with good results, but the rigid bolster is still generally used, and there seems to be no reason why expensive and complicated construction should be employed to dissipate the lateral shock which is not particularly dangerous. Pressed steel shapes have been successfully used in a number of designs of trucks of both the modified arch bar type and the pedestal type.

The most troublesome detail of the modern high capacity car, aside, perhaps, from the draft gear, is that of wheels. The increased amount of energy to be dissipated through the brake shoe, due to higher train speeds and greater loads, has caused a marked increase in the heating effect of the shoe on the wheel, which has been destructive in many cases. The actual increase in load upon each wheel has been met with a better distribution of metal in the wheels, the use of a better mixture and a slight increase in the weight of the wheel. This additional load on the wheel, however, combined with the excessive heating effect due to higher braking pressures has caused the appearance of transverse seams in the tread and a tendency for the flange to break out. This is attributed to the unequal expansion which takes place and the separation of the crystals of chilled iron accompanying such expansion. The makers of iron car wheels still have confidence in their ability to produce a suitable cast-iron wheel for the 100,000-lb. car, and their confidence is shared by a majority of the railroad officers. So far but few trials have been made with the steel-tired wheel for freight service, because it is much too expensive to use, except as a last resort.

The trouble from broken axles under high capacity cars has not been as serious as was at first expected, and the M. C. B. design for journals 5½ in. by 10 in. seems to meet every demand. Within the last year there has been erected at Homestead, Pa., a plant for making hollow pressed steel axles, the claim being made for this process of manufacture that it produces an absolutely sound piece of metal with more strength than a hammered axle and makes possible a saving of about 5 per cent. on the total weight of the car. The rate of production is also said to be much higher than the best practice in making forged axles under a steam hammer.

The design of a suitable brake gear for high capacity cars has been entrusted to a committee of the Master Car Builders' Association. Some change is necessary in the braking power of heavy equipment in order to keep the long trains now used under control. It is probable that either an increase in train pipe pressures will be recommended or a change to a larger brake cylinder and a readjustment of leverage with a strengthening of the foundation gear in either case. Whichever method is adopted, trouble at the wheels is sure to result. There is not much difficulty in increasing the braking power, but there is difficulty in decreasing the serious effects of long continued brake applications on the cast iron wheel.

The most troublesome detail of the modern car is the draft gear. Although within the last two years the friction draft gear has come rapidly into use and justified all the claims made for it, not every one is yet convinced that it will prove to be the solution of the problem. A number of designs of friction gears have been brought out, all of them more or less successful in substantiating the claims made that they do protect the rolling stock from shocks received in fair and unfair service and prevent break-in-twos. The friction gear, however, will never entirely prevent parting of trains until all the cars in the train are protected by it. Far too many railroad officers still adhere to the fallacy that their light capacity cars do not need the protection afforded by friction draft gear as much as their heavy cars do and yet these same light cars are run in trains, sometimes ahead of a long string of heavy cars. The strength of a train is the strength of its weakest car. The abolition of the link slot in the knuckle, the use of a 5 in. by 7 in. shank and the change from malleable iron to cast steel have done much towards diminishing the failures of couplers.

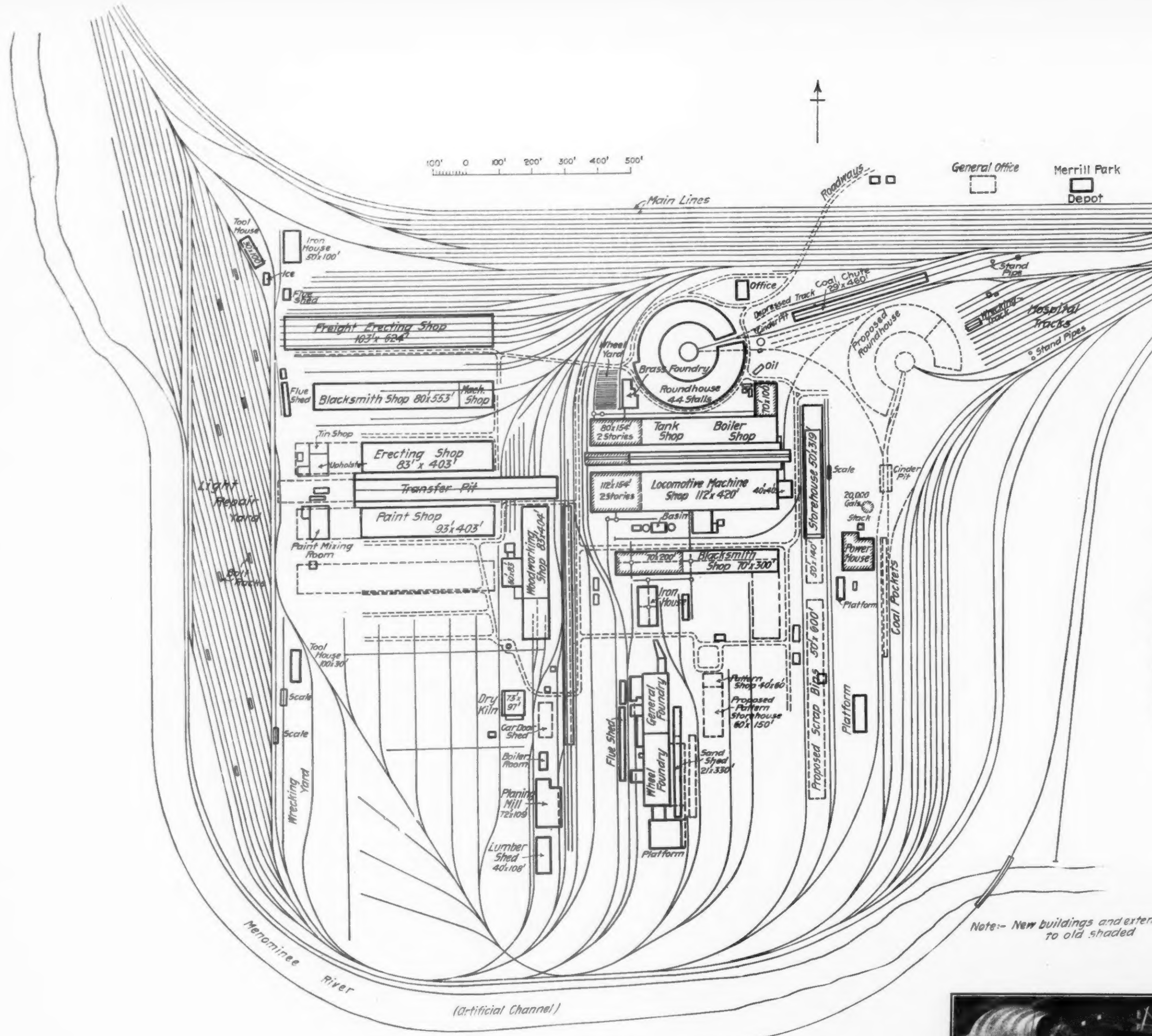
The large number of renewals of wheels from under heavy cars due to worn flanges, suggests the use of anti-friction side bearings and center plates. Anti-friction bearings are now being tried on a number of roads with satisfactory results in reducing the amount of flange wear, but trouble has been experienced in keeping the bearings in good condition. When rounding curves the body bolster is brought down on the side bearings with a heavy blow and when the truck straightens itself out on the tangent the rollers or other anti-friction devices move under a heavy pressure and soon tend to wear flat.

Wooden bolsters, both body and truck, have almost entirely disappeared, and built-up iron or steel, or one-piece cast-steel bolsters have taken their place. Many patented types, using structural shapes, either trussed or not, have been put upon the market, and the variety in cast-steel designs is equally great. The pressed steel bolster has not been altogether a success because much trouble has been experienced by their sagging down at the center plate, and causing the side bearings to carry the load.

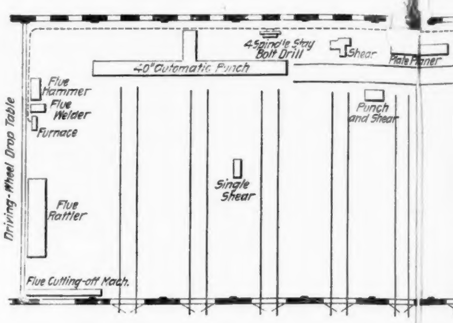
The limit of capacity has been reached for the present with the 100,000-lb. car. Before it can be increased to any amount above that figure, most of the details of car construction must be radically changed from present practice. The same type of draft gear, of wheels and trucks, of bearings and underframes, as used under the 30,000-lb. car, strengthened from time to time to stand the additional burdens put upon them as the capacity has been gradually increased, cannot be made to serve under cars carrying four or five times that load. Future progress in car construction will be along the lines of perfecting the detail parts so that each is as strong as the rest and the combination of the whole equal to any demand for higher capacities within the limits of economical operation in trains.

The American Society and a Union Building.

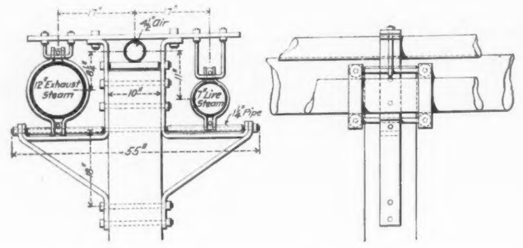
The American Society of Civil Engineers rightly hesitates to accept—without careful study and that due deliberation which can only be had in a long time-interval—Mr. Carnegie's generous offer to house in one building in New York City, substantially at his own expense, the national engineering organizations and the local engineers' club. It was undoubtedly the theory of those splendid men who reorganized the American Society more than a generation ago that it



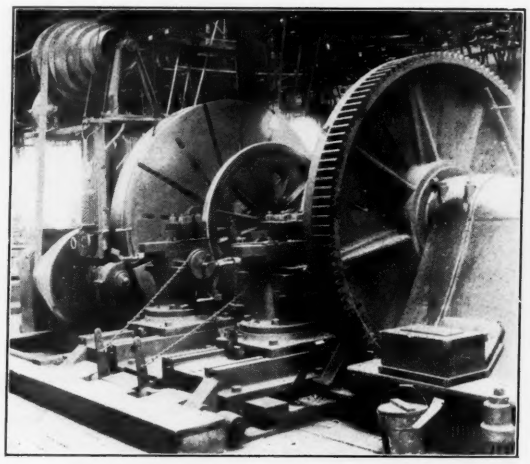
General Layout of Milwaukee Shops, C., M. & St. P.



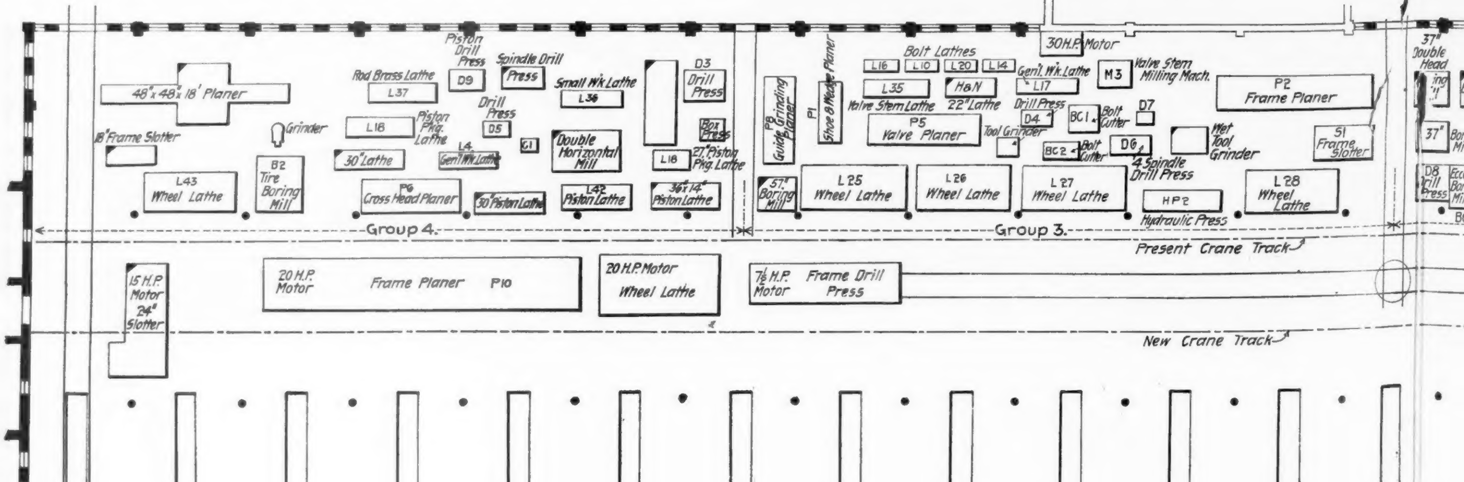
Plan



Detail of Pole Line for Overhead Pipes from Power House.



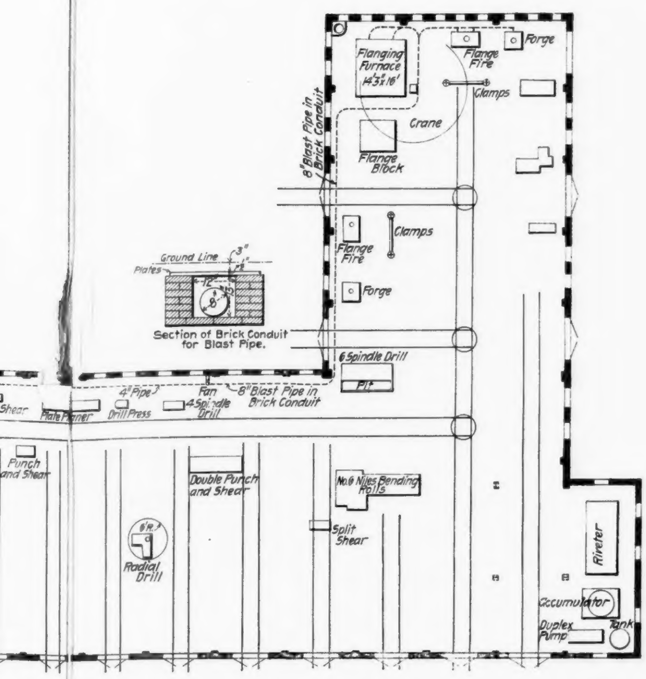
Bement-Miles, 100-in. Driving Wheel Lathe with 20 H.-P. Motor Drive.



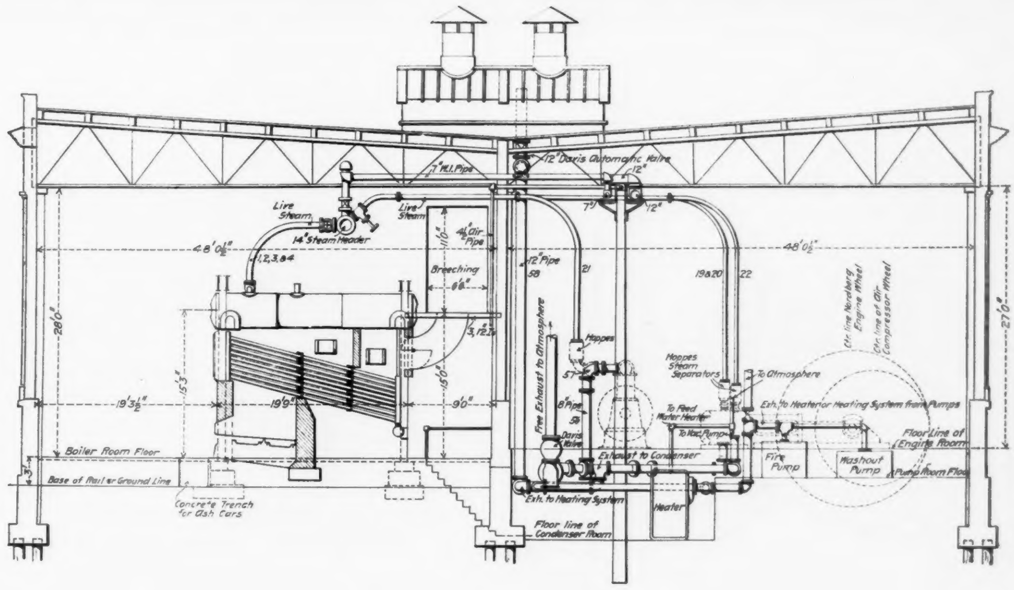
Plan of First Floor of Machine and Erect[ing] Sho[p]

SHOPS OF THE CHICAGO, MILWAUKEE & S[T. PAUL]

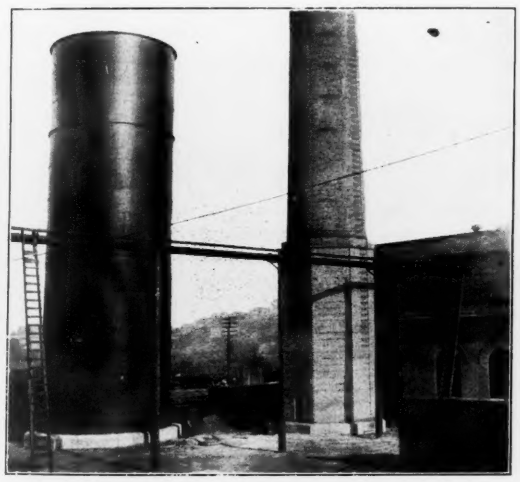
Accompanying an article on Milwaukee

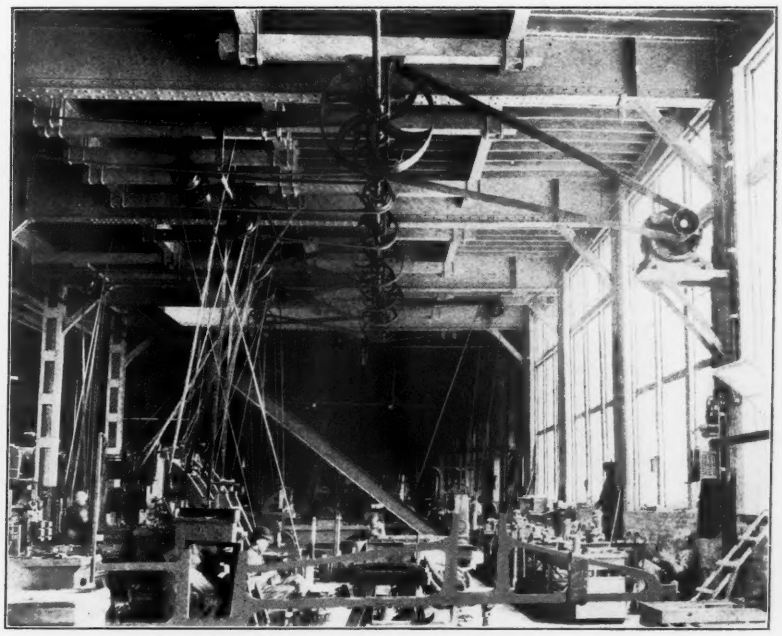


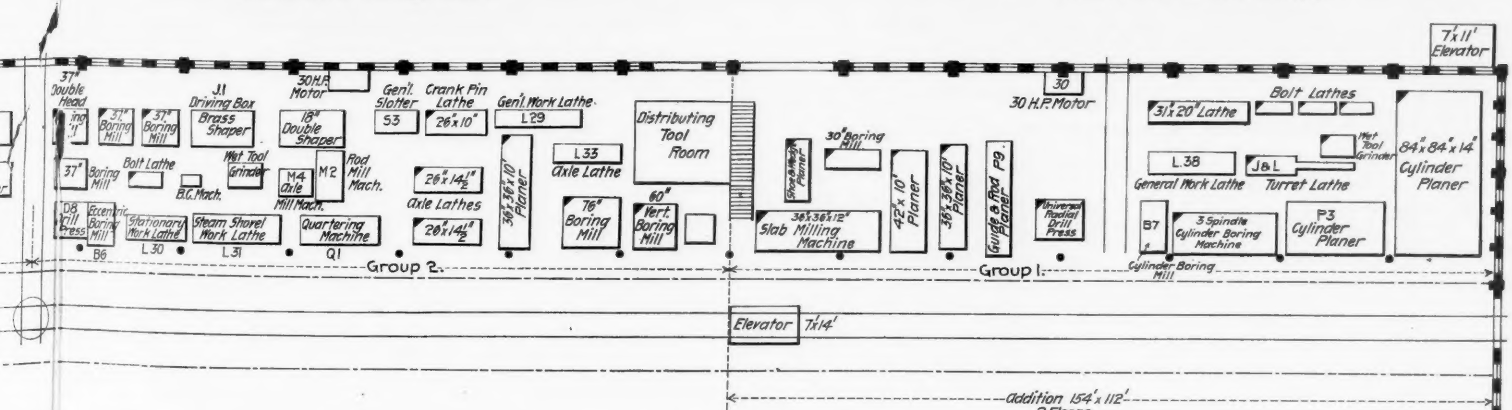
Plan of Boiler Shop.



Cross-Section of Power House.


Power Station, Showing Overhead Pipe Lines and 200,000 Gallon Steel Storage Tank.


Looking East in Machine Shop, Showing Method of Driving a Group of Tools with a 30 H.-P. Motor.



Erecting Shop, Showing Tool Arrangements and Groups.

AUKEE & ST. PAUL AT WEST MILWAUKEE, WIS.

on Milwaukee Shop Improvements, C., M. & St. P.

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should be an Academy, and that only those who were eminent in the profession should enter in. They hoped to keep the membership small, and for this purpose to raise the standard of admission from time to time so as to exclude all but the best. They object to receiving Mr. Carnegie's benefaction because it is not needed for any purpose of the Society, so far as they approve of that purpose. They believe that its acceptance will lower the standing of the Society in the eyes of the world. In the words of one of these great men: "The levelling tendency of our democratic institutions seems to me a serious danger; the labor unions are only the more violent symptoms of a disposition to refuse any acknowledgment of superior merit in science, art or learning." But age should not wither, or custom stale the habit of adapting one's self to changed conditions; with the requirement that no change should be made without full understanding of every important detail, and a long time for discussion and decision.

At the Asheville convention the considerations of sentiment and dignity were finely expressed by Mr. Charles Paine in one sentence: "The same sentiment that makes me prefer a separate home for my family makes me prefer a separate home for the American Society of Civil Engineers." In this respect the project for a union engineering building is simply an apartment house in which the Society may enjoy a separate home with the same slight limitations and somewhat the same advantages had by families in apartment houses in great cities all over the world. There is charm in the idea of physical separation, of a home surrounded by gardens and by goodly walks, where "inventors and manufacturers and dealers in commercial articles" may not enter and interrupt a train of thought; but in a city the same result of isolation is only too easily obtainable by a family or a society in a separate house or in a union building, where next-door neighbors rarely know each other unless such acquaintance happens from another cause than that of propinquity. If the American Society can in the proposed union building be as comfortably housed as it now is, and if its individuality and all the conditions of future stability are as well assured in the new home as they now are, these are good reasons for acceptance; but the dignity due to the quality and size of its membership, to its age and financial position, to the fact that it is the great broad engineering society open to those who are eminent in having "special knowledge of materials, machinery and the laws of mechanics," entitles it to a preponderating influence.

The preliminary and informal conferences with the societies of specialists in engineering and with a social club largely composed of non-professional gentlemen are not at all indicative of the final organization, or of the relations between them. As often happens in such preliminaries, enthusiastic gentlemen have pressed for immediate action, upon conditions believed by themselves to be equitable, but which the American Society could not accept and keep its self respect. This has been a hindrance, but it should not long be in the way.

In a great undertaking of this sort there are sure to be underlying principles which it is well to develop and not lose them in a too early partisanship and discussion of details. The basis of a scientific society is the development of facts, and its form of organization, location and surroundings are properly adapted to this end alone. In this wonderful engineering epoch the American Society has a plain duty to civilization, and in finding its path its eyes should not be blinded by the honorable considerations of tradition and sentiment. It first needs to be learned, whether or not the Society can do more good in the world at Fortieth street than it can do at Fifty-seventh street, and no personal preferences or immature impressions should affect this decision. This needs not only earnest and careful study by the board of directors, who have been authorized to make the investigation, but it also needs time, and it is to be regretted that there are so many who seem to have made up their minds and are already earnest either in advocacy or in opposition to a proposition that is general, to a plan that has been but slightly indicated. It would be indeed strange if so munificent an offer could not be availed of for the good of the profession and for the betterment of the world.

The resolutions adopted authorize the board of directors to investigate, to co-operate in this investigation with the societies of Mining, Mechanical and Electrical Engineers and the Engineers' Club, and to obtain by letter ballot a direct expression of the wishes of all the members of the American Society of Civil Engineers. To this was wisely added Mr. Haines's resolution providing that the letter ballot should be presented to the Society with the usual 60 days' notice and opportunity for discussion at the next annual meeting, in 1904. Pressure or imagined emergency of any sort to the end of shortening this time for full consideration is dangerous. The four societies are now doing invaluable work for the profession, and if their new location and new relations are not wisely adjusted and heartily approved by the members, there is a probability of a loss of efficiency. On the other hand, nothing seems more certain than that a central home is desirable, that Mr. Carnegie's offer makes it possible, and that every difficult problem in the way of it can be solved by the members of a profession whose business it is to solve problems.

Master Mechanics' Convention Reports.

Liberal extracts from the reports presented at the Master Mechanics' Convention are printed elsewhere in this issue, but for the benefit of those who may not have the time or inclination to read them, the following digest of the more important information is given:

Ton-Mile Statistics.—The report of this committee is based on a series of tests of switching engines made by Mr. Geo. L. Fowler, the results of which were published in the *Railroad Gazette* May 8 last. The observations show that the arbitrary allowance of six miles an hour for engines in switching service is much too high, and that, for strictly yard work, "four miles an hour for passenger switchers, and 3½ miles for freight switchers would undoubtedly be a liberal allowance." Further tests will no doubt be made, using a dynamometer at both ends of the engines in order to obtain the average drawbar pull. When this is done, the ton mileage can be computed by dividing the drawbar pull by the train resistance at the average speed, and multiplying the quotient by the total mileage. In the past, there was less need of a ton-mile basis for switching service because most switch engines were about the same size, having cylinders 18 in. x 24 in., drivers 50 in., and a steam pressure of 145 lbs. —the tractive effort being about 18,000 lbs. There are now many switch engines in service having a tractive effort of 32,000 lbs. Evidently the larger engine will do more work in a given time than the smaller machine, and hence the mileage is an unfair basis for comparison.

Electrically Driven Shops.—This is a review of the systems now used for driving machine tools by electricity. The relative merits and cost of each system, as determined from experience, are given. The data on which the report is based are given in considerable detail and will be found invaluable to designers of railroad shops.

Locomotive Front-Ends.—This is a summary of the series of tests which Professor W. F. M. Goss has been making for the *American Engineer and Railroad Journal.* Many of the problems of the front-end have been solved, and it is concluded among other things that the taper stack is more efficient than the straight stack of the same diameter; that the higher the stack, the stronger the draft; and that there is a definite relation between the position of the exhaust nozzle and the diameter of the stack. Equations are given for proportioning the several elements in the front-end for given conditions. Attention is also called to the uneconomical feature of the diaphragm, and it is recommended that further tests be made for the purpose of dispensing with the diaphragm, if possible. About 30 per cent. of the total draft is dissipated in drawing the hot gases from the tubes and under the baffle plate.

Specifications for Locomotive Forgings.—The committee has given a set of specifications for locomotive axles and forgings, covering the physical and chemical requirements of each, methods of making tests and general instructions for inspectors. Three sets of specifications are given, one for driving wheel axles, one for miscellaneous forgings and one for billets. A method is suggested for obtaining test pieces from axles without impairing the value of the axle for service. The specifications have been prepared to conform to those recommended by the International Association for Testing Materials, and the requirements are such that no difficulty should be encountered by the makers in meeting them.

Recent Improvements in Boiler Design.—The report is a comprehensive review of the progress which has been made in the design of locomotive boilers. Examples of modern construction are given, both English and American. Suggestions are made pointing out the lines along which further improvements can be made. The tendency to overcrowd the boiler shell with tubes is criticised, and it is recommended that tests should be made for determining the relative efficiency of long and short boiler tubes.

Piston Valves.—This covers the subject in a thorough and comprehensible manner, and the experience of many roads with different forms of valves is given in detail. The designs of piston valves generally used are shown, and their relative merits are discussed. This subject has been receiving considerable attention, and the piston valve has been, at times, severely criticised on account of its large clearance spaces.

Elsewhere in this issue appears a description of a recent design of four-wheel truck for heavy passenger equipment. The four-wheel truck for passenger cars is still in very general use, but a majority of the heavy Pullman cars and long coaches, owned by the railroad companies, are mounted upon six-wheel trucks, which are, without doubt, easier riding. Theoretically, it is commonly considered that a four-wheel truck, as compared with one with longer rigid wheel base, has less flange wear and causes less rail wear. On the other hand, we know that "easy riding" means diminished destructive forces on the track. The Pullman type of six-wheel truck is a heavy and complicated affair, but it serves its purpose admirably. A simplification of this design that would retain its smooth riding qualities would be a distinct advance. The saving in weight would be one of the most important advantages of the elimination of one axle and its pair of wheels, with the accompanying journal boxes, pedestals, springs, etc. This would lessen the expense of construction and repairs. All of the attempts to produce a truck equal in riding qualities to the six-wheel truck have been mere modifications of the so-called M. C. B. type. Perhaps a modification of the spring arrangement now almost universally used, would make possible a four-wheel truck equal in every way to the six-wheel truck, and much cheaper and more simple in construction. The reduction in weight by using a four-wheel truck is a matter of no small importance. In a 10-car train with six-wheel trucks throughout, the weight of the trucks would be somewhere between 160 tons and 175 tons. The design of four-wheel truck, now shown, and for which is claimed a smoothness of riding as satisfactory as that obtained with the six-wheel truck, weighs but 27,800 lbs. per pair, and a similar train equipped with these trucks would show a saving in weight of from 21 to 36 tons, or slightly less than the weight of one car.

A Philadelphia paper says that three carloads of strawberries were recently sold in Maryland for one cent a quart, because no refrigerator cars could be found in which to send them to New York or Philadelphia; and the editor says that "the railroads must attack in earnest the problem of adequate freight equipment." The successful use of special cars for special services on American railroads is one of the great developments of the past decade. It has been a most important factor in enabling us to compete with the world in iron and steel. It has so broadened and increased the fruit industry as to make it, in a sense, a creation. The season for consumption in the Northern States of perishable fruits has been quadrupled, and this is entirely due to railroad initiative in making a market in Chicago, New York and all northern cities for growers from Florida, Carolina and California to New Jersey and Missouri. What has been done has been well done and there is more to be done, but there are economical limitations. A $2,000 refrigerator car cannot be allowed to stand idle two-thirds of the year. The carrying of freight 1,000 miles for the price formerly asked for 200 is a marvelous development; but this reduction in cost cannot go on forever. The Erie carries milk about 300 miles; and this demands high speed for satisfactory and safe delivery. But editors and other expert economists who want the railroads to "attack" their traffic problems more earnestly, seem to think that 500 or 800 miles can be managed as easily as 300. The Minnesota idea is an example of simple and forcible solution of a transportation problem. The shippers of butter and eggs on the Watertown division of the Chicago & North Western road thought they were not having adequate refrigerator-car service and they therefore got the State Railroad Commissioners to order the road to run such a car (to St. Paul) from Mankato once a week and another from Burr. Whether the shipments of butter amount to more than one tub a week, we do not know; but the method of getting the car is at least beautifully simple and direct. Probably it would be equally lawful for the State of Maryland to order the Baltimore & Ohio to run five refrigerator cars a day out of Baltimore, if the State authorities deemed that number necessary for the promotion of the fruit industry.

Mr. E. P. Bacon, of Milwaukee, Chairman of the Executive Committee of the Interstate Commerce Law Convention, has returned to his home from a trip through the East; and reports that members of the different commercial bodies in the large eastern cities are taking a great deal of interest in the proposition to empower the Interstate Commerce Commission to enforce its rulings. He saw President Roosevelt and found him heartily in favor of this proposed amendment to the Interstate Commerce law. The President received Mr. Bacon cordially, and the interview appears to have convinced the interviewer that "interstate commerce legislation will be an important feature of the work of Congress at the next session." In view of Mr. Bacon's well-known optimism when talking to reporters on this subject, and the apparent lack of vigor in the organization called the Interstate Commerce law convention, the reader must take the foregoing statements for what they are worth; and whether they are worth anything at all is doubtful. The difficulties which have thus far prevented the passage by Congress of anything more radical than the Elkins bill of last February are as great now as they were then. There has been no change. Mr. Bacon persists in talking to the reporters about his hopes, and has nothing to say about practicable plans. President Roosevelt desires to see every good cause prosper—and so do all the rest of us. That appears to be about all the news that Mr. Bacon has given to the public.

Master Mechanics' Reports.

SUBJECTS.

For Investigation by Committee.—First: A standard or formula for use in comparing locomotives, with reference to steaming capacity. An investigation of the various methods of comparison suggested before this association and in the technical press and a definite recommendation which may be used in the design of locomotives.

Second: Electrical equipment of shops and shop powerhouses. What do the manufacturers need to consider to more fully and satisfactorily meet the special requirements of railroads as to electrical machinery?

Third: Boiler tubes. What is the reason for the apparent increase of difficulties with leakage in the tubes of large locomotives? Is the present tendency toward crowding boilers full of tubes in order to secure large heating surfaces a good one? Should not more space be provided between tubes for the improvement of circulation—especially in bad water districts? What is the cause and what is the remedy for leaky tubes?

Fourth: Coal consumption on locomotives. As affected by enginemen, by the size of boilers, by the size of grates and the loss of time on side tracks. Are large grates disadvantageous because of the stand-by losses due to long waits on side tracks? Have recent locomotives with large heating surfaces and large grates, carrying a relatively large proportion of their weights on trucks and trailers, met expectations from the fuel standpoint? If not, is the "large locomotive" justified from the operating standpoint?

Fifth: What is the proper location of water glasses and gage cocks in relation to the crown sheet and the center line of the boiler? What is the proper slope of crown sheets, expressed in inches per foot of length? Is an automatic low-water detector a desirable attachment for general use on locomotives?

Sixth: Automatic stokers for locomotives. Has past experience led to the hope that they may be made satisfactory for general service?

Seventh: Machine tools. What do the manufacturers need to consider in order to more fully meet the requirements of railroad shops?

Eighth: Grates for bituminous coal. What is the best practice to meet various conditions as found in different sections of the country? The subject of grates for anthracite coal was presented to the association in 1897. It is suggested that the same kind of investigation should be made with reference to grates for soft coal.

Ninth: Locomotive frames. The question of design for large locomotives is suggested, with reference to a study of the causes of breakage. How shall the distortions, both vertical and horizontal, be provided for and which deflection is it most necessary to provide for or prevent? Which is the better material, cast-steel or wrought iron?

Tenth: Cost of locomotive repair shops. Power plant —cost per horse-power, separating boilers, engines, generators, buildings, coal and ash handling facilities, piping, switchboard. Locomotive shops—cost per cu. ft. and cost of machinery on the basis of horse-power of tools, with tool list. Countershafting—relative cost of direct driving as compared with countershafting. Piping—cost of air, water and steam. This subject should be treated so as to put shop estimates on an intelligent basis for use in designing new shops.

Eleventh: Rapid destruction of side sheets in wide fire-boxes and the reasons for it.

Twelfth: Best form of radial stays.

Thirteenth: Fire-box steel specifications, including the thickness and spacing of staybolts.

Subjects for Individual Papers.—A. What can be done to retain bright and promising technical-school graduates in railroad service after the completion of special apprenticeship?

B. Organization of the motive power department. Is the ordinary organization now prevailing adequate to cope with the requirements of the times? If not, where is the weakness?

C. Recent progress in the use of oil fuel in locomotive service. What constitutes successful practice?

D. Terminals for locomotives—how may methods for rapidly caring for locomotives at roundhouses be improved? What are the weak spots in roundhouse operation and what is the ideal roundhouse organization? Is it the "big engine" or the roundhouse that has failed?

E. Improved tool steels—what have they done for railroad shop output? What is the relation between tool steel, motor driving and machine tools?

F. By-pass valves for piston-valve engines. Can a piston valve be operated successfully without them? If not what are the elements essential to a satisfactory by-pass valve?

G. Motor driving for locomotive shops. What are the essential principles of successful systems? What are the possibilities and the limitations of variable speeds in railroad shop practice. All things considered, what is the most satisfactory system for railroad shops, as developed in actual practice?

The report is signed by Messrs. G. M. Basford, R. D. Smith, A. L. Humphrey.

ELECTRICALLY-DRIVEN SHOPS.

General Review.—. . . Labor-saving seems to be the keynote in the development of most all recent shop plans. Central power plants with all the latest improvements in the way of coal and ash handling machinery, automatic stokers, direct connected generators and engines, the latter compounded and in some cases condensing, are almost the rule. Such concentration although apparently expensive in first cost permits of the greater economies in the production of the power as a whole, whether of steam, air, water or electricity. Once in the shop, the last named "mode of motion" easily leads in importance and proportionate use. Why? Simply because a charged wire is a more convenient agent for distribution of power than shafting and belting. The latter interferes with crane service, with placing machines in the most convenient ways and places, and this all leads to the conclusion that the modern method is to study movement of material, utilization of labor-saving appliances in handling material, making the arrangement of the tools subservient thereto and in a way of secondary importance.

The one thing that has contributed most to economize movement of materials is probably the electric traveling crane, lifting a single part or perhaps a whole locomotive, carrying and traversing at desirable speeds over the area covered by the span and travel, hoisting and lowering at will great weights with slow, safe speeds and by auxiliary hoists doing rapid work with light weights.

If machine tools are set under a crane span, in most cases they require an individual drive and therein the electric motor proves its superiority as a medium for distribution and its adaptability as an important element of modern shop designs. One may say, if motors are such a good thing why not have all motors and no shafting at all. I quote a recent writer as follows:

"The individually applied motor is now accepted as an established feature in every machine shop. The period of careful investigation, followed by that of cautious probation, is passed, and this type of power application has now been in practical service sufficiently long enough to provide data that can be studied with profit. This data enables one to make more accurate deductions than were possible in the past, and enable those unfamiliar with the art to undertake its application with greater certainty of results."

This, however, is an extreme view and while it is practiced to a limited extent in railroad shops it is believed not to represent good judgment nor engineering. What necessity is there for crane service over small drill presses, small lathes and planers, screw machines, bolt cutters and many such machines? Most of the tools which should be under crane service require considerable power; such as wheel lathes, planers, boring mills and slotters, rolls, punches, shears and heavy engine lathes. The motors for these are large enough to have a good electrical efficiency and a relatively low cost per horse-power as compared with the motors which would be required if the foregoing list of machinery was to be individually driven.

Sufficient belt power is often difficult to obtain to work modern tools to the capacity of some of the improved tool steels and it is much easier to directly gear a motor of suitable size to such machines and by a system of speed control drive the machine up closely to the endurance of the cutting tool.

The recommendation of the committee of 1900 in regard to variable speed motors and "that the attention of the electrical companies should be called to the importance of filling this requirement in their line of standard motors" seems to have borne fruit, as there are now on the market such motors capable of 100 per cent. speed variation, or two to one. By employing the two voltages of a three-wire system a four to one variation is obtained; this, together with suitable gear changes in the machine, will provide for desirable speed variation of tools. The same end may be obtained by the multiple voltage systems.

The alternating current and induction motors were given favorable mention by your former committee and have been used to considerable extent in recent shop installations. While they have undoubted advantages in many ways and may by future development attain to the full field of usefulness of the direct current motors, yet the present state of the art has not qualified them for variable speed work so desirable for individual drive for machine tools. For crane service both direct and alternating motors are used, but the latter require special controlling devices and as yet are not extensively used.

Closely related to the question of power is that of lighting, and in many of the recent installations both power and light are taken from the same circuits, or at least from the same generators with perhaps separate light circuits. Both classes of current are used, the choice being governed generally by local conditions. The three-wire direct current lends itself well in this connection, as 110 volts is generally considered the best for lamps, both arc and incandescent. It also gives 220 volts for constant speed motors for group driving and other work where the class of motors are applicable, also for the crane motors, and both voltages for the variable speed motors for direct driving of individual tools.

It is impossible to say what is absolutely the best system, as no general rule can be laid down to cover the varied conditions, lay-outs and requirements met with in railroad shops. The local conditions of ground, surroundings and requirements as well as the idiosyncracies of the designers of shops make every new one a problem by itself to be solved individually.

Systems and Methods.—The designer of a new railroad shop at the present time, in arranging for the generating station and power transmission, is primarily confronted with the problem of deciding which system of electrical power shall be used, the alternating or direct current. Alternating current is necessarily used in the power plant; and direct current can also be furnished for shop purposes if desired, either by the use of rotary transformers or motor generators, or, in the first instance, by the installation of direct current generators for shop use separate from those used for the long-distance transmission.

On the other hand, no long-distance problems may interfere with the choice of a system, the power plant may be entirely used for furnishing energy to a group of shop buildings sufficiently near together to make a low voltage reasonably economical, and whichever system is used is selected solely with reference to its presumed advantages for shop driving.

The above instances represent the effects of local conditions, and while they may be modified in the first examples by the proportion of the total power required for shop or outside purposes, there are evidently two possible general conditions to consider: First, where it is necessary that alternating current be present in the power house; second, where it is not necessarily present.

To ascertain what percentage of increased output must be obtained to justify the application of electrical speed control it is first necessary to formulate the factors that determine the cost per annum of operating a tool. These are as follows:

1. The direct labor charge per diem.
2. The indirect labor charge, including what are generally known as shop expenses, superintendence, power, lighting, etc.
3. Interest and depreciation charge on the cost of the tool.
4. Interest and depreciation charge on the proportion of cost of machine shop and power plant, including generators, etc.
5. Interest and depreciation charge on switchboard, balances, wiring, motors and controllers, etc.

Of these factors the only one affected by the use of electrical speed control is No. 5, the others being independent of it.

The average annual cost for operating 38 multiple voltage tools based on the Collinwood construction accounts would be:

Item 1	$840.00
Item 2	168.00
Item 3	354.00
Item 4	284.00
Item 5	79.70
	$1,725.70

The total annual cost of operating a tool is thus $1,-725.70 with electrical speed control, against $1,687.10 when driven by constant speed motors, or an increase of 2.24 per cent. In other words it is only necessary to obtain an increased output of 2¼ per cent. to justify the extra expense.

It is true that in the average belt-driven tool the various changes of speed usually vary by increments from 40 to 50 per cent., but it does not follow that the work performed need vary in any such ratio. In any given material with the same cutting tool, which is being operated to its capacity, the amount of metal that is removed in a given time depends on three factors—the cutting speed, the feed and the cut. If a machine were employed steadily upon work in which the material were of uniform hardness, and the dimensions of the pieces the same, it would probably be possible to get the same output when the speeds vary by 40 per cent. steps as when they vary by 10 per cent. by the adjustment of the feeds and cuts, but even assuming this to be exactly true, it is a condition that does not obtain in the majority of machine shops, and is practically absent in railroad shops.

It is difficult to adjust an ordinary belt-driven tool to the best cutting conditions, and it may be taken at the best to run as nearly as the cones allow, say within 20 to 25 per cent. of the maximum on the average. With electric control the machines can be run within 10 to 15 per cent. of the possible speed, giving an increased output theoretically of at least 10 per cent., and in practical working a great deal more, from the closeness of the speed control alone, to say nothing of the saving of time in the manipulation of the machine resulting from this system. On wheel lathes, there is a special advantage, that when one or two hard spots occur in a tire, the machine can be slowed over these spots and the speed restored for the balance of the circumference.

If it were decided to direct-connect all tools, the limiting factor affecting the application of speed control is not the size of the tool, but the wages of the operator: the smaller the tool and the less the horse-power required to drive it, the less is the additional expense of applying electrical speed control and there is consequently but little difference in the increase in output required to compensate for the additional investment. On a tool costing $500 and requiring 3 h.p. to drive it, the items are as follows:

Item No.	With speed control.	Without speed control.
1	$840.00	$840.00
2	168.00	168.00
3	75.00	75.00
4	66.00	66.00
5	69.00	34.50
Total	$1,218.00	$1,183.50

a difference of $34.50 or 2.8 per cent.

The whole question is up to the machine tool builders. If they can furnish tools which can be direct-driven for the same price as when belt-driven, then it will cost no more to direct-drive tools than it does to belt-connect them in groups, and when this can be said the advantages of individual driving will make this practice preferable.

. . .

The report is signed by Messrs. C. A. Seley, Chairman; H. H. Vaughan, T. S. Lloyd, T. W. Demarest, L. R. Pomeroy.

LOCOMOTIVE FRONT-ENDS.

Since the conclusions derived from the tests being carried out by Purdue University, under the arrangements made with the *American Engineer*, were not immediately available when this committee was appointed, it was deemed inadvisable to hold an early meeting as instructed by the Executive Committee, and action was therefore deferred until Professor Goss presented a complete report. On receipt of this it was at once seen that a most valuable addition to existing information on the front-end problem had been made and that the experiments certainly decided the relations of the stack and nozzle definitely and finally so far as it could be possible to do so on a testing plant.

A Summary of Results.—The more important conclusions to be drawn from the results of the tests may be briefly stated as follows:

1. All portions of the smoke-box which are in front of the diaphragm have substantially the same pressure; and, consequently, a draft gage attached at any point may be depended upon to give a true reading.

2. The resistance which is offered to the forward movement of the air and gases between the ashpan and the stack, may be divided approximately into three equal parts, which are: First, the grate and the coal upon the same; second, the tubes, and third, the diaphragm. It is significant that the diaphragm is as much of an impediment to draft as the fire upon the grate.

3. The form and proportions of the stacks for best results are not required to be changed when the operating conditions of the engine are changed. That is, a stack which is suitable for one speed is good for all speeds, and a stack that is suitable for one cut-off is good for all cut-offs. In future experiments of draft appliances, therefore, results obtained from a single speed and a single cut-off should be deemed satisfactory.

4. Other things remaining unchanged, the draft varies with the weight of steam exhausted per unit of time; if the number of pounds of steam exhausted per minute is doubled, the draft, as measured in inches of water, is doubled; if it is halved, the draft value is halved.

5. As regards the form of outside stacks, either straight or tapered may be used. From a designer's point of view, the tapered is the more flexible, that is, with the tapered stack, the draft is less affected by slight departures from standard dimensions. Incidental reasons, therefore, make the tapered form preferable. For best results, the diameter of a given straight stack should be greater than the least diameter of a tapered stack for the same conditions.

The term "tapered stack" used in this and other paragraphs signifies a stack having its least diameter or "choke" 16½ in. from the bottom, and a diameter above this point which increases at the rate of 2 in. for each foot in length.

6. In the case of outside stacks, either straight or tapered in form, the height is an important element. In general, the higher the stack, the better will be the draft.

7. The diameter of any stack designed for best results is affected by the height of the exhaust nozzle. As the nozzle is raised the diameter of the stack must be reduced, and as the nozzle is lowered the diameter of the stack must be increased.

8. The diameter of a straight stack designed for best results is affected by the height of the stack. As the stack height is increased the diameter also must be increased.

9. The diameter of a tapered stack designed for best results, as measured at the choke, is not required to be changed when the stack height is changed.

10. The precise relation between the diameter of front-end, and the diameter and height of stack for best results, is expressed by equations as follows:

For Straight Stacks.

When the exhaust nozzle is below the center line of the boiler,

$$d = (.246 + .00123\ H)\ D + .19\ h.$$

When the exhaust nozzle is above the center line of the boiler,

$$d = (.246 + .00123\ H)\ D - .19\ h.$$

When the exhaust nozzle is on the center line h is equal to zero and the last term disappears and there remains,

$$d = (.246 + .00123\ H)\ D.$$

For Tapered Stacks.

When the nozzle is below the center line of the boiler,

$$d = .25\ D + .16\ h.$$

When the nozzle is above the center line of the boiler,

$$d = .25\ D - .16\ h.$$

When the nozzle is on the center line of the boiler, h becomes zero and

$$d = .25\ D.$$

In all of these equations, d is the diameter of the stack in inches. For tapered stacks, it is the least diameter or diameter of "choke." H is the height of stack in inches and for maximum efficiency should always be given as large a value as conditions will admit. D is the diameter of the front end of the boiler in inches, and h the distance between center line of the boiler and the top of the exhaust tip.

Problems for Further Study.—The Chicago & North Western experiments (Master Mechanics' Association Proceedings, 1896) settled all questions relative to the form of exhaust pipe and tip, and the *American Engineer* tests, as described in this report, are equally conclusive concerning the proportions of an outside stack when used in combination with nozzles of different heights. When, therefore, designers are content to employ plain forms of construction, the whole problem of front-end design may be considered solved. But conditions have of late arisen which enforce the use of stacks so short that the best proportions which can be given them do not yield satisfactory results. As a consequence, practice now tends along new lines for which there is little data that can be of service to the designer. That this deficiency may be supplied, it is necessary that the plan of tests already followed be extended to include other forms of mechanism. This is the more desirable since the results desired are not likely to be forthcoming from the road, but, on the contrary, can best be obtained from the laboratory. The fact, also, that a large amount of data which will serve as a base line from which efficiencies of other apparatus may be measured, has already been collected from the Purdue locomotive, and the fact, also, that the work already done suggests the elimination of certain variables and a corresponding reduction in the number of observations hitherto considered necessary, all suggest the desirability of continuing the investigation along the general lines of the *American Engineer* tests. If this should be agreed upon, the work should, in the opinion of the undersigned, be made to include the following subjects:

(a) Inside Stacks, by which is meant a stack of usual form, but which instead of being entirely above the smoke-box extends downward into the smoke-box as well as out through its top. Where conditions are such that the portion of the stack extending outside of the smoke-box is necessarily short, this arrangement is much used. The *American Engineer* tests have already included some observations on a straight inside stack of a single diameter, but the results obtained are not sufficient to serve as a basis for general conclusions. That the required data may be obtained, it will be necessary to employ stacks of at least three different diameters, and each diameter should have three different degrees of penetration into the smoke-box. Some additional work, also, may need to be done to determine the best form of the lower portions of the stack. It will be sufficient to employ the tapered form of stack only, and to have the outside length of stack constant.

The application of these stacks of different sizes will involve some cutting of the smoke-box, and the change from one stack to another may make the progress of the work slow, and, consequently, somewhat expensive, but the results will be worth the pains, for there is no other way by which the desired information may be obtained.

(b) Draft Pipes in Connection with Outside Stacks.—It has been suggested that a draft pipe, or a combination of draft pipes, may be accepted as a complete substitute for an inside stack, and many roads are using them, apparently with good results. The experiments should deal first with a single draft pipe which should be varied in diameter and vertical position until the best diameter and position can be definitely chosen. After this, the progress should be repeated in connection with a double draft pipe. A comparison of results thus obtained, with those obtained from the outside stack without draft pipes, should disclose the value of the draft pipes, and similarly a comparison of results obtained with those given by the inside stack should show whether the draft pipes are to be preferred to the inside stacks.

(c) False Tops Within the Smoke-Box.—A number of railroads are now following the practice of blanking off the upper part of the smoke-box in such a manner that a stack of ordinary form may start from a point which is lower than the top of the boiler. The arguments in favor of such an arrangement are to be found in the fact that while the stack has the character of an outside stack, it can be made of greater length than would otherwise be possible. Whether there is any loss of efficiency resulting from the reduced height of the smoke-box, and, if so, whether it equals or exceeds the gain resulting from the increased length of the stack, are important questions. To settle this, experiments with false tops of at least three different forms should be made, in combination with stacks suitable for each form. A comparison of results with those obtained under the provisions of preceding paragraphs would show to what extent, if any, such an arrangement is superior to others which are more common.

(d) Diaphragm.—As is well known, the diaphragm is not common in foreign practice, while in American practice its presence greatly impedes the forward movement of the gases. For this reason it would be well if it could be wholly omitted. It remains, however, to be determined whether there is any combination of nozzle and stack which in its absence will give satisfactory draft and at the same time draw equally on all tubes. The undersigned are not prepared to outline in detail a series of tests which will settle this question, but believe it to be of importance, and that the means to be employed will be apparent as the work outlined in the previous paragraphs proceeds.

With full information concerning the relative value of the inside stack, draft pipes, the false top and the diaphragm, and with data which will permit any of these to be at once so designed as to give maximum efficiency, the problem of the front-end, so far as it can be seen at present, is solved. While work of this character can be started and advanced slowly at small cost, it would be well if it could be vigorously pushed. To do this it will be desirable to have both the laboratory and the computing room manned at the same time, and to have assigned to the work an expert of sufficient ability and leisure to insure the prompt handling of all experimental results. Money will also be needed to supply and attach the special equipment and to defray the usual running expenses of the laboratory. While, therefore, much might be done at small cost if plenty of time were available, the best policy requires that there be available a sum of from $5,000 to $7,000, at least $4,000 being available for the first year's work. Upon this basis the remaining problems of the front-end could soon be definitely solved.

The engine on which these tests were made had a front-end 54 in. in diameter, and the conclusions adapting the results obtained on this engine to those of a larger size were obtained by considering the diameter of the front-end as a unit, and increasing the size of the stack in direct proportion. While this may be a correct method we feel that since all locomotives recently built or that are liable to be constructed in the future will have front-ends of considerably larger size, this subject will not be left in a satisfactory condition unless further tests are carried out to confirm or correct this assumption.

We were advised by Professor Goss that it would not be possible to carry out further tests in continuation of the *American Engineer* series prior to June, 1903, on account of the conditions at Purdue University, and we also anticipated that considerable difficulty would be experienced in obtaining the use of a sufficiently large engine with the present demand for power. It was, therefore, decided to request those members who formed the original committee to assist in the *American Engineer* tests to make experiments in service to confirm the results obtained by Professor Goss. The majority were compelled to reply that, owing to the large amount of work then being carried on in their respective departments, they would be unable to assist during the present year and only three series of tests have been carried out. These have only been partially made and the results are not sufficiently complete to present in this report, although they practically confirm the conclusions arrived at on an engine having a front-end of the same size as that used at Purdue University, but leave it open to question whether these results are immediately applicable to engines having a considerably larger front-end. We are pleased to be able to announce that through the courtesy of one of the members of this association, Mr. J. F. Deems, General Superintendent of Motive Power and Rolling Stock, of the New York Central & Hudson River Railroad and Lake Shore & Michigan Southern Railway, arrangements have been made by which a large modern engine, having a front-end 75 in. in diameter, will be available to allow this series of tests to be completed. This will enable the determination of the correct unit to be used for stack diameters to be made, and a further series of tests carried out along the line recommended by Professor Goss. Your committee, therefore, asks to be continued in order that during the coming year it may carry out the purpose for which it was appointed.

The report is signed by Messrs. H. H. Vaughan, Chairman; F. H. Clark, A. W. Gibbs, W. F. M. Goss, Robert Quayle.

PISTON VALVES.

The type of valve more generally favored is either the hollow internal admission or hollow external admission, and while there is a fair proportion of solid internal admission valves there are very few solid external admission valves in use unless we consider the piston valve used on the Vauclain compound as being of this type. In classifying replies it has been considered that this valve was of the hollow external admission type. As to which type is believed to be the most economical very few expressions of opinion have been given, the experience generally having been confined to one type of valve. There are, however, some exceptions to this. The Boston & Maine said that for economy, as regards steam distribution, the hollow internal admission valve or the hollow external admission valve is preferable, as the steam passages are freest with these types, and for steam consumption the inside admission valve appears best. The first cost depends largely on the kind of packing rings, the outside admission valve costing somewhat more on this particular road on account of having to make valves, valve cases and packing rings of different sizes at the front and back ends of valve, due to equalizing the two ends of the valve stem. For maintenance they prefer the inside admission hollow valve because but one size of case is required, one size of packing ring to be kept in stock, and the metallic valve stem packing wears much longer. Also the valve is easier removed and there seems to be less wear on the valve gear on inside admission valves.

The Delaware & Hudson says: "In the spring of 1902, Messrs. Campbell and DuBois, seniors of Cornell University, made a comparative test in freight service of Class E-2 and E-3 engines. The engines were loaded propor-

tionately to tractive power. Deductions from this test show a saving on the piston valve engine of 1.8 per cent. The piston valves were new, and the slide valves were recently shopped." While not so stated, this economy is apparently due to steam distribution, and as the percentage of gain is so small it is questionable if, after the elimination of errors of observation, there would remain any advantage.

As regards the ratio of diameter of cylinder to diameter of valve both in simple and compound engines there seems to be a large variation between the maximum practice and the minimum practice. In simple engines the ratio varies from 1.66 to 2.1 For the Vauclain compound system the high pressure varies from 1 to 1.38, and for the low pressure cylinder from 1.67 to 2.30. The variation in the other types of compounds is not so marked, due to fewer replies being received covering these types. It is the opinion of the committee that the lower ratios indicate the better practice and that the higher ratios should only be used on freight and switching engines.

The methods of obtaining relief from water and extra pressure is generally provided for by relief valves in cylinder heads. In some few cases there are, in addition, by-pass valves, relief valves in steam chests and on the compound engines, relief valves in low pressure ports, and on the end of a hollow valve stem. There is one exception to the above. The Southern Pacific uses a circulating pipe. As regards the value of the various types of relief valves from water, it is not thought that the valve in the cylinder head fulfills its function in the manner that it is expected to. It has been the experience of one road that these valves, after being in service for a short time, corrode, or through other causes fail to lift at the pressure at which they are set, and that they are of but little value. As to relief when drifting, very few of the by-pass valves or relief valves are thoroughly successful where the speed is high. It is possible that the circulating pipe previously referred to will do this to a greater extent than the other devices. Referring to the reply of the Southern Pacific, and quoting: "The circulating pipe sent herewith shows an arrangement that not only takes care of compression and surplus moisture, but will also take care of the temperature of cylinders when drifting. It takes care of the partial vacuum that is responsible for the incandescent gases of the smoke-box entering the cylinders through the exhaust nozzle. The piston valves in constant use for the past two years with this circulating device are in perfect order to-day, with little if any wear. The cost of caring for the piston valves during this time has been nothing more than that of bushing the front end horn or guide when the engines were shopped."

No affirmative replies were received to the question regarding the use of piston valves with collapsible packing rings, although it is known that such valves are in use on two roads, and that on both of these roads their service has been very satisfactory. The theory of this type of valve is that steam pressure being admitted through cavities under the packing rings, sets them out against the valve cage, but that when they are so set out, due to the different angles of the different rings composing the packing, they lock in this position and the valve practically becomes a plug valve. It will be generally conceded that the plug valve has some advantages over the other types, and that its great disadvantage is due to the wear of valve and bushing so as to gradually permit steam to pass between. It would seem, however, that this type of valve, being adjustable, would overcome this objection.

Various types of packing rings are in use, as well as rings of the same style varying greatly in their dimensions. The rectangular cast-iron snap ring, together with the cast-iron "L" ring, appears to be used in the majority of cases, while for the rectangular rings about ⅝ in. by ½ in. and for "L" rings ⅝ in. by ½ in. seem to be the prevailing sizes. In some of the valves provided with followers, heavier rings are used, and it is questionable if the prevailing practice is not too light rather than too heavy. As regards the advantages of the rectangular and "L" shaped rings, it would seem that the rectangular rings generally have the advantage of strength, longer life, cheaper cost and cheaper maintenance, while to offset this, the "L" ring, especially on high-speed engines, gives a very much better port opening with less wire drawing. The "L" ring naturally has a greater unbalanced surface than the rectangular ring, and it is the experience of one road that it wears both itself and the chamber very much more rapidly than the rectangular ring. Your committee believes that in most designs the extension part of the "L" ring projects too far. As to the efficiency or economy of various types of rings, only one road has any data, the Chicago, Milwaukee & St. Paul furnishing a print of a special type of valve ring. From the indicator cards (not shown.—Editor) it would seem that the steam distribution appears as good on one side as on the other, while they report that this bushing and ring have been in service on the right side of the engine for one year, the left-hand side being equipped with the regular bushing and rings. An examination made about a month ago shows that the valve having diagonal bridges and the broad ring was in perfect condition and had all the appearances that would indicate another year's service without repairs, while the opposite side, having the regular type of rings and bushings, had to have chamber rebored and new rings applied; the service thus far obtained from the bushing with the diagonal bridges and the broad ring packing seems to be very favorable. The general practice as regards the number of rings per end seems to be two, although there are several exceptions where three rings are used.

Relative to exhaust effect, the Chicago, Burlington & Quincy says that "we have made experiments on valve friction of internal admission piston valves of both hollow and solid types. With the solid valve, cards taken show that at slow speed there is an excessive push forward on the valve when exhaust first opens. The average pull on the solid type of piston valve in comparison with the balanced and unbalanced slide valve shows that with the hollow type of piston valve we get more uniform pull than with the solid type. However, with the end of the valve travel there is a sudden increase of pull which corresponds to the point of exhaust opening."

The Boston & Maine says: "We observed that when our first consolidation engines arrived, they soon began to sound badly out of square, the indicator diagram showing that the valves were not cutting off equally, yet no discrepancies could be found in the valve setting or motion work. The defect was attributed to the removal of pressure from the back end of the valve by the valve stem, the greater pressure on the front end keeping the slack all taken up in one direction and allowing the valve to keep as far back as possible. This condition existed for speeds up to 30 miles an hour, above which, apparently, the inertia of the parts overcame the unbalanced force. The inequalities of the exhaust sound increased with increased slack in the motion work. The trouble was overcome by enlarging the back head of the valve by an area equal to the area of the valve stem." Your attention is called to the other method of eliminating this difficulty by the use of an extended valve stem, several styles of which are shown in the different types of piston valves illustrated.

No experiments seem to have been made with a view to determining the steam lost due to worn rings, and judging from remarks made at the topical discussion on this subject at last year's meeting, it would seem that there is a wide variation of opinion as to the amount of this loss. One road says that while having made no accurate tests to determine the steam loss due to wear of packing rings, two of the Master Mechanics who had made shop tests believe that the rings can easily represent a loss of 15 per cent. over the steam consumption with rings in first-class condition. It undoubtedly varies, due to several conditions—the type of ring, the size of ring, the type of valve and the time between reboring of valve chamber casings and application of new packing rings. One road says that where piston valves are used on engines, when on account of heavy grades there is a long drift, the frequent reboring of valve casings is economical in the long run as preventing broken packing rings and blowing.

Only two roads replying to the circular acknowledge having had any experience with the new type of American balanced slide valve. One of these says that two engines are so equipped with most excellent results. The other has had four engines equipped for about a year's time, and, with the exception of some minor difficulties in the start which were later overcome, the results have been very good. The valve has both double admission and double exhaust features, and while no indicator cards have ever been taken to show how much has been gained by this feature, there can be no question but that it is an appreciable factor. With this type of valve, all balancing parts are stationary and not subject to wear, and in two different ways a very short steam port may be obtained. By making a wide shallow exhaust cavity in the cylinder, a short steam port can be obtained. The other method by which this can be accomplished is to use inside admission, as there is nothing in the way of balancing this valve equally as well for inside as for outside admission, although it is believed the latter has not yet been tried. It also has the advantage of providing for relief from over pressure in the cylinders by lifting in the same manner as the ordinary slide valve, and on account of the double exhaust feature there must be considerable decrease in back pressure, which is evidenced to a certain extent by the very short, sharp exhaust.

The replies as to the chief advantages of piston valve seem to be fairly uniform and consist, in the main, of better balancing, which includes ease of handling and decrease in wear and tear of motion work. In addition, some replies give less cylinder clearance, better steam distribution, less cost for maintenance, shorter steam passages, decreased back pressure, better distribution, larger port openings; and on the four-cylinder compound the fact that the piston valve really takes the place of the two valves, in that it distributes the steam to both high and low pressure cylinder, greatly simplifies the motion work and the number of parts. It is questionable if all the advantages claimed are real and tangible, as it seems that some of these attributes can be obtained equally as well or better with other types of valves. It would seem that the question of lubrication is not a settled one.

One road says that where engines with piston valves have to drift for long distances the question of properly lubricating the piston valve becomes a very serious problem, and it is hoped that a discussion of this paper will bring out some more definite information on these points. It would seem that the reason for the growing favor in which the piston valve is held is due largely to reasons as given by one of the roads in reply to the circular, as follows: "Our reasons for taking up the piston valve are that with the increased size of engines and steam pressure the ordinary balanced 'D' slide valve increases in size proportionately, and while we may balance the valve in the same ratio as the valves on the smaller engines, the difference in unbalanced surface increases with the size of the engine. This increases the wear on the valve and link motion, eccentrics and straps, and increases the work necessary on the part of the engineman to handle the engine." The foregoing reasons probably cover the situation, the Lake Shore saying that on a very careful test, an economy of about 5 per cent. was shown, which they considered due to decrease in back pressure and perhaps slightly to decrease of amount of compression.

Among the defects, as given for piston valves, the most general are difficulty in lubrication and maintenance of relief valves, broken packing rings, edges of grooves in spool breaking, liability to blow, inability to keep steam tight and excessive wear of bushings at short stroke. In addition to this, the Lake Shore calls attention to the fact that it finds in connection with the piston valve, considerable trouble with main driving box. This is also the experience of another road, it being found that main driving boxes wear very rapidly so as to have side play and pound, making it necessary to rebore very frequently. In a letter to the committee, which the author did not desire to have published in connection with his signature, the question as to lubrication when drifting is brought up, and he says that on the road with which he is connected it is a very serious problem to lubricate the piston valve under such conditions.

In reply to the question as to with which type of valve the wear and tear is greatest, the majority of replies state that it is less on the piston valve. One road qualifies this by saying that it depends on conditions, and that if the latest type of balance valve is used the wear and tear is decidedly less with the slide valve. Another road says that it is about equal, while many give no opinion whatever, and one road states that the wear and tear is much greater on the piston valve.

Only one road replies as to the efficiency due to worn rings for varying mileages, the Burlington & Missouri River Railroad in Nebraska saying that if the piston valve is put up properly and regularly inspected there will not be any appreciable loss after making 45,000 miles, but otherwise the loss through leakage of steam will be so noticeable after making 15,000 miles that the engine would not be in very good condition.

As to which of the rings is most responsible for decreased efficiency due to wear there seems to be a decided difference of opinion. Some roads say the exhaust ring and some other roads say the steam ring, while the majority say either no data or no opinion.

Four general designs of bushing seem to be in general use—the continuous bushing with straight bridges, the continuous bushing with diagonal bridges, sectional bushing with straight bridges and sectional bushing with diagonal bridges. There does not seem to be any decided opinion as to which is the better type. In connection with the continuous bushing, an interesting suggestion is contributed by the Chicago & North Western, in which they say that they prefer a single bushing and one having the fits at the two ends slightly different so as not to have to force the bushing the full length of the cylinder. The use of the diagonal bridges probably reduces the liability of broken packing rings, and will also probably give a little more wear, but it is questionable if the increased cost over the straight bridge warrants the use of this type. With simple engines using the piston valve the general preference seems to be for two bushings, one at either end of the piston valve chamber, although there are several cases where the continuous bushing is used on the simple engine. With the compound engine it becomes desirable on account of the number of ports to use the continuous bushing, and this type is used exclusively on the Vauclain compound piston valve.

In a majority of cases a knuckle joint or Scotch yoke is used. In some cases, however, it is not used where the valve stem is long. There seems to be no doubt that for best results with wear of packing rings and valves some device should be used so as to remove all tendency for valve wearing within the valve chamber, and to resolve all forces acting on the valve into one parallel with the valve stem.

On late compound engines with the piston valve, of the Vauclain type, a hollow valve stem with extension for relief valve supported in both front and back heads seems to be generally used. On simple engines, in some cases an extension is also used, but the opinion that the same is necessary is not general. Equal results are sometimes obtained without the extension.

From the replies to some of the questions it is very evident that little or no data is available on some of the subjects brought up in connection with the piston valve. Your committee, therefore, recommends:

First.—That tests be made to determine the loss of steam due to worn packing rings. Such tests should include the various types of rings illustrated in the report.

Second.—That tests be made to determine whether the steam or the exhaust rings are responsible for the decreased efficiency due to wear.

Third.—That the question of proper lubrication of piston valves when drifting be more thoroughly investigated.

Fourth.—The attention of the committee being called to the question of valve setting in connection with the piston valve, after it was too late to include it in the circular, by one road saying that with identical valve motions, to obtain equal work, modifications in the piston valve setting must be made, it is suggested that further investigation be made along this line.

The report is signed by Messrs. F. F. Gaines, Chairman; R. P. C. Sanderson, F. H. Clark.

REVISION OF STANDARDS, RECOMMENDATIONS AND RESOLUTIONS.

Standard Sizes of Nuts and Bolt Heads.

The committee recommends the adoption in full of the M. C. B. Standard on this subject as it stands. The M. C. B. Standard is better covered and provides for the distinction between the rough and finished sizes of nuts and bolt heads.

Sheet Metal Gage.

The committee has no recommendations to make.

Distance Between Backs of Flanges.

At the convention of 1884, the distance between backs of flanges for tender, locomotive trucks and driving wheels was made not less than 4 ft. 5¼ in., nor more than 4 ft. 5½ in.

The committee on flanged tires in 1900 concluded that it was desirable to set front and back tires on consolidated engines with a distance between backs of flanges of 4 ft. 5⅛ in.

Therefore, the committee recommends the distance between backs of flanges be changed to read "to be not less than 4 ft. 5⅛ in. nor more than 4 ft. 5½ in."

Limit Gage for Round Iron.

The committee has no changes to suggest.

Driving Wheel Centers and Size of Tires.

Driving wheel centers seem to afford in a large majority of cases, sufficient diameters, but quite a number of locomotives have been built lately that use wheel centers not conforming to Master Mechanics' Standard.

The committee does not recommend any further addition to wheel center standards, believing them to be in the main satisfactory. We recommend that a committee be appointed to revise the shrinkage allowance to provide for the necessary difference between cast-iron and cast-steel centers, also to provide for the proper shrinkage allowances for the larger diameter of tires which are not now provided for, namely: 70, 74, 78, 82, 86 and 90 in.

Section of Tire.

In the section of tire there is a draftsman's error.

The Master Mechanics' Standard shows a cylindrical tread for a distance of 1 in. from the root of flange, and the M. C. B. Standard tread shows a conical tread coned ⅛ in. in diameter ($^1/_{16}$ in. on a side) in the first 2⅜ in. from the root of the flange. The difference is slight, but it causes manufacturers of tires some trouble in rolling tires to meet both specifications. As there appears no good reason for the difference in the two standard sections, the committee recommends that the drawing of section of tire conform to M. C. B. section.

Boiler and Fire-Box Steel Specifications.

The committee recommends that the boiler and fire-box steel specifications be revised, and that a committee be appointed for that purpose.

Efficiency Tests of Locomotives.

The committee believes these need no revision.

Specifications and Tests for Iron Boiler Tubes.

The committee recommends that these be revised and provide for steel tubes.

Decimal Gage.

The committee has no recommendations to make.

Briggs's Standard Wrought Iron Pipe Threads.

We find that many manufacturers do not adhere to these standards, but the remedy lies with the consumer to specify Briggs's Standard for wrought iron or steel pipe threads.

The committee has no further recommendations to make regarding this standard.

Square Bolt Heads.

The committee has no recommendations to make.

Mileage Allowable.

(1) Switching engines; (2) Local freight engines; (3) To and from roundhouse; (4) Switching service on through freight and passenger engines.

The committee recommends these mileages should be omitted.

Betterment of Engine Equipment.

The committee recommends this subject be omitted, as in our opinion it is an auditing matter.

Axles—3¾ by 7 in. Journals and 4¼ by 8 in. Journals.

The committee recommends the addition of M. C. B. Standard Axles with 5 by 9 in. and 5½ by 10 in. journals to above recommendations, and adopted as standards of the Association.

Journal Box and Contained Parts, Cars and Locomotive Tenders.

The committee recommends that the M. C. B. journal boxes and contained parts for all M. C. B. Standard Axles should be adopted as standards of the Association.

Specifications and Tests for Cast-Iron Wheels.

We recommend that a committee be appointed to revise these specifications and bring them up to date, and applicable to present requirements for dimensions for cast-iron tender, and engine-truck wheels.

Air-Brake and Signal Instructions.

We recommend that a committee be appointed to confer with a similar committee from the M. C. B. Association, and from the Air-Brake Association, and present a revised code of rules at the next convention.

Code of Apprenticeship Rules.

The committee has no changes to recommend.

Resolutions.

The committee recommends the omission of the following resolutions from Proceedings:

Safety chains on all trucks.

Loose wheels and compound axles.

Steel for fire-boxes.

Under resolution covering brick arches the convention of 1888 passed the following resolution:

"That it is the sense of this convention that a brick arch applied to the fire-box of the locomotive is a desirable addition for all service, and a positive advantage."

There are many types of engines in which a brick arch is not possible as well as not desirable. The committee recommends that this resolution be omitted from the Proceedings.

The report is signed by Messrs. T. A. Lawes, Wm. McIntosh, A. M. Waitt.

STANDARD PIPE UNIONS.

Your committee was instructed to correspond with manufacturers, presumably with a view to suggestions and criticisms. As this was very thoroughly done by the committee of the American Society of Mechanical Engineers, before making their final report, your committee has received no suggestions which had not been previously considered.

This report is signed by Messrs. C. H. Quereau, Chairman; Thomas Fildes, E. M. Herr.

TON-MILE STATISTICS.

The committee was continued with the special purpose of making recommendations as to the proper ton-mile credit for switch engines. In this connection the results obtained by Mr. Geo. L. Fowler, through an investigation made for the *Railroad Gazette* and published in the issue of May 8, 1903, are exceedingly interesting.* . . .

In view of the care with which these records were taken, the length of time covered in each case and the fairly close agreement of the several records, it seems fair to conclude that the results agree reasonably with the facts. On this basis, three miles an hour for switch engines doing freight work and three and one-half miles an hour for passenger switch engines, appear to be a fair credit. If we had equally reliable data as to the average tonnage handled, a comparatively accurate credit of tonmileage could be proposed, but inasmuch as we know of no such records and the credit would be an arbitrary one, we have thought best to make no recommendation. In view of these facts we would recommend that no further action be taken by this association and that the committee be discharged.

The report is signed by Messrs. C. H. Quereau, Chairman; G. R. Henderson, George L. Fowler.

RECENT IMPROVEMENTS IN BOILER DESIGN.

The Committee on "Recent Improvements in Boiler Design" decided to divide its report into two parts, Part I to describe recent boilers, both American and foreign, for different classes of service and for various kinds of fuel, and Part II to determine so far as possible how satisfactory recently built boilers are and what principal troubles are experienced with them.

Part I.—Progress in boiler design may be said to be along the lines, and in pursuit of, increased efficiency as a steam generator, rather than in perfection of constructive details which affect first cost and that of maintenance. Your committee, believing that a graphic representation would convey a clear conception of the present status of boiler construction, has selected some examples (not shown) of the product of 1902-3—both American and foreign—for the different classes of service, which embrace designs for bituminous, anthracite, and lignite coals, and also oil, for fuel. The accompanying table furnishes particulars for heating surface for each boiler, as well as other points that will make comparisons of interest.

The most prominent features of design to attract attention are those of heating surface and grate area. Professor Goss pretty nearly exhausted the boiler-power question when he said: "The maintenance of pressure in the cylinders demands steam from the boiler, and the limit of cylinder work is reached when the boiler can no longer meet the demands made upon it." This is all fundamental, though recent, but is in strong contrast with the old order of things where cylinder dimensions alone signified a powerful engine.

The boiler of 1903 is designed with special reference to well-defined conditions, in which the horse-power involved is provided for by a heating surface and grate area, of proportions that are expected to unfailingly supply the cylinders. That these expectations are fully met is attested by the performance of the latest engines.

The wide fire-box which is rapidly becoming recognized as a standard form of construction, is responsible for the extraordinary length of tubes on engines which, on the 4-6-2 type, reach a length of 20 ft. in some cases, made necessary by placing the wide fire-box at the rear of six-coupled 80-in. wheels. Foreign builders are regarding with favor the trailing truck design, since they gain a grate area impossible of attainment in the older form of passenger engines, and to this is due the appearance abroad of the 4-4-2 four-cylinder compounds of the Baden State Railroad with 42 sq. ft. of grate area. The De Glehn 4-cylinder balanced compound is also the 4-4-2 type, although it has not the fire-box extending over the frames, but the design of engine lends itself to such construction which will doubtless be seen on future engines of the De Glehn type.

A reference to the table herein will show how extensive has become the tendency to increase heating surfaces for the new conditions, over those recommended in the report submitted to this Association in 1897. The ratio of fire-box heating surface to total as given therein was 10 per cent. The large fire-box heating surfaces shown are five per cent. and under in some instances, for which the enormous number of tubes is responsible. This is plainly evident in the Chicago & Alton 4-6-2 engine, which has the lowest percentage of fire-box to tube surface among the passenger engines. This engine was dsigned for an especially exacting work which demands an unfailing boiler power. The New York Central 4-4-2 engine has demonstrated the necessity of a boiler with unlimited steaming capacity, in numerous performances with a total load of engine and train of more than 730 tons at speeds of over 55 miles an hour.

It will be noted that the foreign engines have a ratio of fire-box to tube surface more nearly in harmony with the work of the committee referred to. The 4-4-2 De Glehn 4-cylinder balanced compound engine of the Northern of France has made a record for development of a high horse-power on a very small heating surface, contending with 0.5 per cent. grades at a speed of 74 miles an hour, with 295 tons of engine and train. More than 1,500 De Glehn engines are now in service. The 0-10-0 three-cylinder simple engine of the Great Eastern of England has boiler proportions of the greatest magnitude of any of the foreign engines, having been designed for suburban passenger service in which stops are numerous, with a gross load of 414 tons. This work requires the engine to accelerate quickly, therefore the small wheels and large boiler, the latter feature being an innovation in English design.

The London & Southwestern has more than 100 of the Drummond water-tube boilers in service, and it is stated that all locomotive boilers of this road are now being fitted with cross water tubes. Under this system, the fire-box heating surface is increased nearly 100 per cent. by means of the water tubes, and equals 30.8 per cent. of the total. This would appear to be a practical illustration of the ancient proposition, that the higher the percentage of fire-box heating surface to total heating surface, the greater the evaporative efficiency of the boiler, a statement that remains to be controverted. A boiler of this character, but with water tubes in the fire-box only, has been designed by Mr. Riegel of the American Locomotive Company. This system contemplates two nests of water tubes extending from center of crown sheet diagonally down to side water spaces, by which it is claimed to be possible to get over 1,800 sq. ft. of efficient heating surface in the fire-boxes of the larger types of engines, making a total heating surface of over 6,000 sq. ft. There is no doubt of the necessity of such a design, since fire-boxes have about reached the limit of size, both from a clearance standpoint as well as that of operation. There is no record of any construction of this idea.

Superheating of steam is attracting considerable attention abroad, particularly on the Prussian State Railroads, where 70 engines are fitted with the Schmidt system of superheating. In addition to these the Schmidt principle is in use on the Alsace-Lorraine State railroads, the Belgian State railroads, the Moscow-Kasan Railroad, the Southern of Italy, and the Munich Suburban Railroad. In this country the same superheating device is in use on the Canadian Pacific, and the American Locomotive Co. is now constructing another engine similarly equipped for the same road. It is understood that there are also five of these engines under construction by the Pennsylvania road. Very glowing accounts of the performance of Schmidt engines, by an American engineer who has recently returned from Europe, would imply that there were economies in superheating steam for locomotives.

Even with the successful overcoming of resistance at continuous high speeds there is a question among some officials that, while we have ample heating surface, it may not be in the right place, or, in other words, it is possible that we have too much heating surface in the wrong place, that is, are not too many tubes used, and would not a boiler furnish an equivalent or a higher evaporation with a lesser number? There appears to be good reasons for questioning the efficiency of a multitude of tubes, among which are the following for reducing the number: A better circulation due to the wider spacing of centers; a reduction of liability to leakage, and longer life to tube sheet due to the greater section of material between holes. It is not apparent that there are any very serious difficulties to surmount in making tests that will demonstrate to what extent evaporation and cost of maintenance is affected by a wider spacing of tubes. Such experiments would definitely decide whether the practice of encroaching on circulation space with tubes is conducive to an economical evaporation, and in addition would no doubt incidentally furnish some needed light on the effect of a higher ratio of fire-box to tube heating surface under the new conditions. Restricted water spaces around the fire-box are well known to be inimical to a proper circulation, as well as dangerous to the sheets, and the same effects are known to operate at the fire-box ends of tubes. The wide fire-box has shown a marked tendency to crack at the sides, and as a remedy it is proposed to make the fire-box ring 4½ in. wide on some engines now under construction.

In bracing and staying there is little to be recorded as new. In joint construction the welt type is said to be improved to an efficiency of 90 per cent. of the solid

*The article was reprinted in the report, but is here omitted.

plate, and welding of joints is said to be satisfactorily done, both on dome sheets and longitudinal joints, the latter, however, not continuous but at ends only.

The reason for the increase of heating surface being one of boiler power to meet the greater demands of the cylinders, it is plain that the question of design should have direct reference to the amount of water evaporated by each sq. ft. of heating surface per hour. If the heating surface is designed for the work to be done, that is, on a horse-power basis, then the problem becomes one of design for specific conditions. In that case the facts entering into calculation are: (1) Resistance to overcome. (2) Horse-power required. (3) Water consumption per horse-power hour. (4) Water evaporated per sq. ft. of heating surface per hour. (5) Evaporative value of one pound of coal. (6) Grate area to accord with calorific value of fuel.

This process has to do with actual values only, eliminating all factors of doubtful utility. . . .

Part 2.—(The report contains a detailed list of the replies received from various roads. These are not given. —EDITOR.)

The committee has reached the conclusion that boiler troubles have increased in proportion to the increase in size and steam pressure of boilers. Those roads having very little trouble with old boilers are having very little more with modern boilers, and those which have always had a good deal by comparison, are having a good deal more with their modern boilers. Poor water is evidently the chief cause of boiler troubles, though it is evident that poor coal, severity of service, contracted water spaces, etc., contribute to an aggravation of the trouble. It would appear also that in poor water the incrusting solids are not always the governing factor, but that other solids also have their effect in producing cracked side sheets and leaky flues.

One horse-power for 3 sq. ft. of heating surface seems to be about all that can be safely relied upon as a regular performance with water ordinarily found in the Middle and Western States, but this can be improved upon where water is of better quality.

There seems to be no question but that the wide grate is at least 10 per cent. more economical than the narrow, in burning bituminous coal, but that its economy while running is to some extent offset by its comparative waste of coal while standing idle on side tracks or at terminals, and this waste appears to increase proportionally to the increase in grate area.

No conclusion could be made as to the maximum grate area which a fireman can economically fire, but it no doubt depends on the quality of the coal, and for a clinkering coal would appear to be in the neighborhood of 45 sq. ft.

Treating water in locomotive tenders is undoubtedly beneficial, provided it is followed up with frequent blowing down and washing out, in that it retards the formation of scale and overheating. The quality of the water may be so poor, however, as to require so much soda ash or other reagent and hence so much washing out that the good effects of the soda ash are offset by the bad effects of too much washing out. The correct method of treating water appears to be in station tanks, so that solid matter does not get into the boiler, but even by this treatment there seems to be danger of making the water so alkaline as to foam badly.

There is less trouble from broken staybolts and cracked side sheets with the wide fire-box than the narrow, but about the same amount of flue trouble, although several roads state that they have more leaky flues in wide fire-boxes. The general opinion is that the deeper fire-box over trailers is more satisfactory than the shallow box over drivers.

In general there is no increase in foaming or priming in high-pressure boilers, but the committee would recommend as much steam space as is possible to get and a comparatively high dome.

Unless water is exceptionally good, the width of mud ring should be not less than 4 in. and the space at crown sheet not less than 7 in., believing that it will result in much longer-lived side sheets and considerable reduction in broken staybolts.

A large majority of the replies express a preference for 3/8-in. side, door and crown sheets, and 1/2-in. flue sheets.

Double riveting mud rings, scarfing sheets at corners and an inside radius at ring of 2 to 3 in. appears to overcome all trouble from leaky mud rings.

A majority of roads sending replies consider one door sufficient for wide fire-boxes, and where there is trouble from door sheets cracking, the most satisfactory method of flanging appears to be to flange both sheets out the inside sheet to have large radius.

A majority of roads appear to use drop grates and the need of them no doubt increases with the tendency of the coal to clinker.

Flexible staybolts are still in the experimental stage.

The economy of the brick arch seems to be unquestioned, especially in deep fire-boxes, but in shallow boxes and those subject to leaky flues, it is not much favored. Water tubes are the favorite means of supporting brick arches where the water does not cause them to give trouble. Where water is poor the supporting of arches on angle irons or studs in side sheets is preferable.

In general, the committee believes that the large, high-pressure, wide-grate boiler can be designed to give but little more trouble than the old-style low-pressure boilers, even where poor water is used, except as regards flue trouble, which appears to be quite general and with most roads quite serious. Wide water spaces around the fire-box will prevent cracked side sheets and broken staybolts to a large extent; good design will stop door-sheet and mud-ring trouble; wide bridges will prolong the life of flue sheets. A large number of flues, closely spaced, severity of service, poor water, contracted steam space, shallow depth below flues have retarded circulation to such an extent that flues and back-flue sheet are frequently and highly overheated. Wide fire-boxes, poor coal and poor firing admit large volumes of cold air against overheated flues and sheets and the wide range of temperature to which flues are subjected loosens them circumferentially and draws them in and out longitudinally. Flues are frequently found so loose that they can be shaken in the sheet. Short pieces of flue rolled into a piece of 1/2-in. fire-box steel in the usual manner, heated to a dull red and suddenly cooled require a considerable number of heatings to make them loose.

An experiment was made to determine the temperature surrounding flues by plugging certain flues at both ends with asbestos and placing asbestos plugs 2 ft. apart throughout the length of the flue with two pieces of fusible metal in each space, one piece melting at 410 degrees to 420 degrees and the other from 440 degrees to 450 degrees Fahr. The temperature surrounding flues was considerably above the temperature of saturated steam at 220 lbs. at the back end and in the case of upper flues it was higher all the way through.

If the surrounding temperature is so high in a flue thus plugged it must be still higher about flues through which fire is passing, and it is probable that the temperature at the flue sheet is very much higher. There is no evidence to prove that a flue will not stand a considerable amount of overheating without leaking but it would appear that those that are leaking are subjected to too high and too great a range of temperature.

It is only necessary to have a sufficient body of water against side sheets to reduce cracked side sheets and broken staybolts to a minimum. It should follow that flues can be spread far enough apart to stop their leaking, but the spreading of flues reduces the heating surface very rapidly and the widest spacing the committee has knowledge of, namely, 3 1/2-in. centers for 2-in. flues, has not cured the trouble.

In conclusion the committee would recommend the appointment of a committee for the ensuing year to further investigate the question of leaky flues.

The report is signed by D. Van Alstyne, Chairman; G. R. Henderson, T. W. Demarest, O. H. Reynolds, John Player.

AMERICAN LOCOMOTIVES.

Builder.	Built.	Railroad.	Type.	Boiler pressure, lbs.	Cylinders, diameter and stroke, in.	Diameter drivers, in.	Weight on drivers, lbs.	Weight, total lbs.	Htg. surface fire-box, sq. ft.	Htg. surface, total sq. ft.	Tubes, number.	Tubes, length ft. and in.	Grate area, sq. ft.	P. c. fire-box to total htg. surface.	Fuel.
Am. Loco. Co.	1901-2	N. Y. Central	4-4-2	200	21x26	79	95,000	176,000	180	3,505	396	16	50	5.1	Bit. coal
Am. Loco. Co.	1902-3	Penna. R. R.	4-4-2	205	20 1/2x26	80	109,000	176,000	166	2,640	315	15—1	55.5	6.2	Bit. coal
Am. Loco. Co.	1902-3	C. R. R. of N. J	4-4-2	210	20 1/2x26	85	99,400	191,000	174	2,967	325	16—6	82	5.86	Fine ant'cite
Am. Loco. Co.	1902-3	Northern Pacific	4-6-2	200	22x26	69	134,000	202,000	175	3,462	301	18—6	47	5	Bit. coal
Bald. Wks.	1902-3	C. R. R. of N. J	2-6-2	200	18x26	63	108,000	165,000	137	1,832	249	13	54.5	7.47	Anthracite
Bald. Wks.	1902-3	Chicago & Alton	4-6-2	220	22x28	80	141,700	219,000	202	4,078	328	20	54	4.95	Bit. coal
Am. Loco. Co.	1902-3	C., B. & Q.	2-8-0	210	22x28	57	187,000	208,900	195	3,827	462	15	54	5	Bit. coal
Bald. Wks.	1902-3	B., W. & Gt Falls	2-8-2	200	14 + 24x26	50	128,000	166,900	174	2,496	270	16—6	56	6.97	Lignite
Bald. Wks.‡	1902-3	A., T. & S. Fe	2-8-0	210	17 + 28x32	57	191,400	214,600	165	4,266	652	13—7	..	3.86	Oil

FOREIGN LOCOMOTIVES.

Builder.	Built.	Railroad.	Type.	Boiler pressure, lbs.	Cylinders, diameter and stroke, in.	Diameter drivers, in.	Weight on drivers, lbs.	Weight, total lbs.	Htg. surface fire-box, sq. ft.	Htg. surface, total sq. ft.	Tubes, number.	Tubes, length ft. and in.	Grate area, sq. ft.	P. c. fire-box to total htg. surface.	Fuel.
P. L. & M. Wks.*	1902-3	Paris, Lyons & M.	4-4-0	213	13 3/8 + 21 1/4 x25 7/16	78 3/4	74,800	99,400	129	1,934	150	11	26	6.7	Bit. coal
Von Borries	1902-3	Baden State	4-4-2	235	13 3/16 + 22 7/16x24 3/8	82 5/8	70,500	163,700	145	2,260	279	15—9	42	6.37	Bit. coal
De Glehn§	1902-3	Nor. Ry. of France	4-4-2	228	13 3/8 + 22x25.2	80 5/8	71,200	142,100	167	2,275	126	13—9	29.6	7.34	Bit. coal
Holden†	1902-3	Great Eastern	0-10-0	200	18 1/2x24	54	134,400	134,400	131.7	3,010	395	15—11	42	4.37	Bit. coal
Drummond	1902-3	London & S. W.	Drummond water-tube boiler						229	742	No data	No data	20.3	30.8	Bit. coal
Borsig Wks.	1902-3	Prussian State	Schmidt's superheating system						...	...	...	......	...	....	....

‡ Tubes, 1 3/4-in. * Four-cylinder compound, Serve tubes 2 1/2-in. § De Glehn and Du Bousquet 4-cylinder, balanced, compound, Serve tubes 2 3/4-in. † Holden's 3-cylinder simple suburban engine, 10 coupled.

DRAWBAR AND BUFFER ATTACHMENTS FOR USE BETWEEN ENGINE AND TENDER.*

The design of a proper draft connection between engine and tender is, at the present time, one of great uncertainty, and yet, viewing the rapid growth of modern power, no single feature of locomotive construction merits more serious consideration. This uncertainty has arisen from the lack of general appreciation of the real forces concerned, and from our failure to recognize and employ such figures as dynamometer records have in the past suggested, as well as other data. Only within a short time have careful tests been made in the measurement of stresses produced in drawbar attachments of any sort, and the results of these have indicated figures much larger than anticipated. Relative to these tests, Mr. Marshall comments as follows:

"It is found, on the road, with a skilful engineer on the engine, that the tensile and buffing stresses seldom exceeded 50,000 lbs. and 80,000 lbs., respectively; with a less skilful engineer, however, the stresses increased to about 70,000 lbs. and 150,000 lbs., respectively. An engine coupling onto its train gives stresses ranging from 65,000 lbs. to over 142,000 lbs.; a switch engine coupling onto the dynamometer car standing alone gave a stress of 103,673 lbs.; when a string of loads was behind the car, the switch engine coupling on gave a buffing shock of 199,482 lbs.; and 30 loaded cars, moving at about six and one-half miles per hour and coupling onto the 10 loads with brakes set, gave a shock of 376,492 lbs. It would seem reasonable, in view of the above figures, to require draft gears to be capable of withstanding tensile stresses of 150,000 lbs. and buffing stresses of 500,000 lbs."

In demonstrating the effects of elastic impact between cars, Mr. R. A. Parke refers to similar tests where a maximum pressure of initial impact of 370,709 lbs. was followed in reaction by a tension in the drawbar of 73,828 lbs. where spring draft gear was used. These figures confirm, from another standpoint, the results previously noted.

As an initial step in this investigation, it seemed important to obtain as concise information as possible concerning the present state of the art, and accordingly inquiries were addressed to three prominent locomotive builders and to 25 railroad companies, selected as far as possible with a view to covering all sections of the country, asking for representative designs pertaining to the arrangement of buffer attachments between locomotive and tender, together with comments thereupon. In response to these inquiries replies were received in which were presented past experience, present practice and incidental recommendations for the future, accompanied in almost every case with descriptive matter and blue-prints.

The three fundamental elements of a drawbar attachment between engine and tender are essentially:

1. The drawbar itself which receives the tensile stresses.
2. The buffers, or chafing irons, which receive the stresses of compression, or impact.
3. The safety device, which comes into play only in case of failure of the drawbar.

An examination of the designs reveals the fact that uniformity of practice has not obtained, nor, in general, has sufficient capacity been provided for modern requirements. With the three fundamental elements always in mind, the designs seem to have drifted along independent lines, as local conditions or personal convictions have dictated.

Drawbars have been used in which the difference in level of drawbar ends has been as great as 7 in. However, the universal verdict of the present time is in favor of the straight horizontal drawbar, and representative recent designs now rigorously adhere to the latter practice. Spring buffers have been largely used with various dispositions of springs for the purpose of taking up the slack, while some roads still adhere to the rigid chafing blocks. Many roads still use the time-honored safety chain. There are interesting deviations from this practice, however, as for instance the practice of substituting for this office a pair of bars, similar in appearance to the drawbar itself. From efficiency in service and facility in coupling up the tender, this would seem to be a commendable practice. An interesting adaptation of the coil spring in connection with the safety chain between engine and tender to assist in absorbing the shock due to the parting of the drawbar, is used on the New York, Ontario & Western.

Coming now to that part of the subject, "What should be the form and relative strength of drawbar to tractive power of the engine and what offset in the drawbar is permissible?" some little ambiguity arises from the dual-

*Extracts from a paper read at the 1903 meeting of the American Railway Master Mechanics' Association, by Henry Bartlett, S. M. P., B. & M.

ity in conception of the expression "offset." In the majority of cases, this is construed as meaning the difference in horizontal plane of the ends of the bar. Obviously the tendency of such inclination of the drawbar is relatively to elevate or depress the front end of the tender, and, for a constant length of drawbar, such tendency increases with the increase in difference in height.

The lifting effect has these objections: weight is transferred from the front truck of the tender to the rear of the engine, whose spring rigging has not been designed to carry this additional burden, and since this force is a function of the drawbar pull of the engine, it is necessarily intermittent. Moreover, the removal of weight from the tender has been known to cause sliding of tender wheels when brakes were applied. Since the increase of stress in the drawbar due to this inclination is merely the difference between the horizontal stress, and the resultant of this with the lifting force, and is comparatively slight, this consideration is not vital so far as the strength of the drawbar itself is concerned.

For purposes of discussion, it seems more important to adhere to the other construction of this term, and to specifically define offset, as the maximum distance which the neutral axis of any section departs from a straight line connecting the centers of the drawbar pin bearing surfaces.

This offset may, of course, be made anything that seems necessary, if adequate strength is provided. This means that if offset is unavoidable in conforming to existing conditions upon old foot-plates and tender draw castings, then proper consideration must be given to the stress due to the bending moment, in addition to that credited to the drawbar pull. This bending moment is the product of the dimension "A" into the drawbar pull. The extreme fiber stress, due to bending, is obtained by the usual formula:

$$f = \frac{M\,y}{I} \text{ whence the combined stress becomes}$$

$$f_1 = \frac{M\,y}{I} + \frac{P}{A} \text{ where } M = \text{bending moment.}$$

y = Distance of extreme fiber from neutral axis.
I = Moment of inertia of section with respect to its center of gravity.
P = Drawbar pull.
A = Area of section.

To illustrate this, take an actual case:

Tractive power of engine is 21,600 lbs.
Greatest offset = 3¼ in.
Drawbar is 4¼ in. wide and 2⅜ in. deep at point of greatest offset.

$$f_1 = \frac{21{,}600 \times 3\tfrac{1}{4} \times 1\tfrac{3}{16}}{\dfrac{4\tfrac{1}{4} \times (2\tfrac{3}{8})^3}{12}} + \frac{21{,}600}{4\tfrac{1}{4} \times 2\tfrac{3}{8}}$$

$$= \frac{21{,}600 \times 3\tfrac{1}{4} \times 1\tfrac{3}{16} \times 12}{4\tfrac{1}{4} \times (2\tfrac{3}{8})^3} + \frac{21{,}600}{4\tfrac{1}{4} \times 2\tfrac{3}{8}}$$

$$= 17{,}570 + 2{,}140 = 19{,}710 \text{ lbs. per sq. in.}$$

At the point of maximum offset, the most favorable section to resist bending is that wherein the long axis of the section is in a vertical plane. This observance is rare, and a reason why it may not better be utilized lies in the fact that where an offset is made, it is to avoid contact with some rigid part, and to increase the radius of gyration in the vertical plane tends to remove the center of gravity still farther from the line of direct stress; in other words, there is more offset than there was before.

The foregoing serves to emphasize the truth that offset is undesirable, as it entails additional weight of metal, and in general a cumbersome design. As to the form, since the later tendency is correctly toward the straight bar, the rectangular section with its long axis in the horizontal plane is most favored. It is suggested as good practice to reinforce each end of the bar by hubs in a manner to lengthen the pin bearing within a reasonable limit. In one arrangement these hubs have been placed upon opposite sides of the bar, apparently with a view to minimize the effect of the necessary inclination. A form of drawbar end is employed upon the Pennsylvania Railroad, the B. & O. and several other roads, in which the pinholes are rounded in the vertical plane section.

The practice in connection with the use of this bar is to bring the engine end of the bar ¾ in. high at the start, so that when 1½ in. of metal is worn or turned off of the tires, this end will stand correspondingly ¾ in. low, neglecting consideration of wear on tender wheels.

The apparent decreased pin-bearing surface brought about by so rounding the holes in the bar has given rise to question as to the propriety of this practice, yet the fact that no ill results have been experienced with the use of a reasonably long radius vertically would seem to justify the practice. Moreover this form has a tendency to confine the center of stress near the center line of the bar.

It would seem reasonable to recommend that the working stress be 4,000 lbs. per sq. in. of section for straight drawbars. It must be recognized, however, when large offsets are necessary, concessions in the factor of safety must be made, and in such cases it would be reasonable to set 12,000 lbs. per sq. in. as the maximum permissible limit. Taking the customary figure of 28,000 lbs. per sq. in. as the probable ultimate strength for repeated stresses of tension, this would indicate that the strength of the drawbar is from 7 times to 2⅓ times the tractive power of the engine. A limit of working stress, used in conjunction with some rational assumption relative to stresses due to shock and reaction arising from the sudden application of air-brakes, for instance, should receive great consideration.

Of those parts whose office it is to care for the buffing, or compressive stresses, it is well to consider the so-called spring buffer first. The elementary features of this device may be mentioned as follows: The buffer (a) with its hollow cylindrical shank within which nestles the spring (b), which, in turn, finds resistance in the bottom of the buffer pocket (c) whose walls enclose the shank of the buffer. The base flanges of this pocket are bolted to the rear of the engine or front of tender as the case may be, a retaining screw (d) is provided to preserve the integrity of the spring buffer when engine and tender are uncoupled. The counterpart of this buffer is a plain block, or chafing iron, whose broad face is presumably always in contact with the buffer, so that the engine and tender are forced apart sufficiently to take up the slack between them and to provide means of absorbing the minor vibrations, or shocks, due to the restless movement between engine and tender.

No form of spring buffer has proved to be thoroughly successful, and I seriously question the soundness of the principle upon which this design, as it now stands, is founded. The investigation of the action of the friction draft gear between cars, as compared with that of the twin spring rigging, exhibits clearly the disadvantage of impact elastic to this extent. These same disadvantages appear in the spring buffer. Where we may count upon a buffing stress of 300,000 lbs. to 500,000 lbs. at times, it is obvious that the twin spring, whose capacity varies from 20,000 lbs. to 40,000 lbs., will be almost instantly closed solid, permitting the balance of the shock to be taken by the casting and the vehicle to which it is secured. To increase the capacity of the spring, even if practical considerations of coupling up would permit, means only to add a corresponding stress in reaction upon the drawbar during the initial period of restitution. To substitute heavy steel castings, as has been done, to receive the balance of the shock which the spring fails to absorb, serves primarily to preserve the spring buffer attachment, but merely transfers the shock to the machinery of the locomotive. This same conception seems to have been noted earlier in car work. Mr. Carney once made a remark, at a meeting of the Western Railway Club, relative to this point. "If part of the car fails, and is strengthened, that part ceases to break, but some other part that has been strong enough before commences to fail, and in that way we go from the knuckle pin on one end of the car to the knuckle pin on the other end."

In the present designs the spring buffer brings with it a spacing or separation between engine and tender which the inadequacy of the spring turns into nothing better than slack, so-called. Without the space element, difference in momentum between engine and tender becomes impossible. Some method of adjustment and frequent inspection that will tend to reduce this space element or slack between engine and tender to its very lowest terms, thus permitting them to become essentially a unit as affecting stresses in the direction of tractive effort, is the ideal connection.

One road in abandoning the spring buffer has settled upon the policy of installing heavy rigid chafing blocks, allowing the wear in the drawbar and pins to accumulate until the riding of the engine renders the condition intolerable, when the drawbar will be inspected and shortened. This is assumed to provide a safeguard against the breaking of drawbars, but it appears to involve too much of the human element to satisfactorily solve the problem. Some enginemen will endure a large amount of discomfort while the protest of the engine parts themselves comes too late to be of service.

There are two possible solutions of the buffer problem: (1) the institution between engine and tender of some form of coupler after the fashion of the M. C. B. vertical plane device, modified to adjust itself more comfortably to short curves in the track than might be possible with the present design.

(2) The alternative suggested would be to revert to the first principle of the adjustable wedge in taking up the slack.

A common form of the adjustable chafing block now in use has the parts made of steel, and no excessive trouble from the breakage is experienced if the slack is properly followed up. It will be noted that the rubbing surface is necessarily flat, and that the drawbar is consequently stretched on curves unless considerable initial slack is provided. Moreover, there is a tendency to wear a depression opposite the tender chafing block, which becomes eccentric after an adjustment of the wedge. It would seem proper, therefore, to suggest the use of rigid chafing blocks with surfaces curved from the drawbar pinhole as a center, and to provide the adjustment by placing one of the pins in a sliding block, adjusted by wedges. Such slack, however slight, as may be considered the maximum allowable before an adjustment of the wedge should have a corresponding consideration in the strength of the drawbar.

I make the following as a final recommendation:

1. That the provision for buffing stresses take the best possible form of an adjustable wedge.

2. That the drawbars be straight, even at the expense of redesigning foot plates and tender front draw castings in new work and renewals.

3. That the drawbar pinholes be provided with ample bearing area.

4. That an elongated eye be provided at one end to prevent the bar from coming over into compression.

5. That sufficient stock be provided at both ends to prolong the wear in the pinholes.

6. That 4,000 lbs. be the working stress with straight bars.

7. That the drawbar shall be of the best material, and that a limit shall be set to the repetition of welding a bar in repairs.

Finally, that a system of inspection of drawbars and related gear at stated frequent intervals be instituted and rigorously observed.

SPECIFICATIONS FOR LOCOMOTIVE AXLES AND FORGINGS.

The committee has presented three distinct specifications; one for steel driving and engine truck axles, another for locomotive forgings for the use of such roads as are in the habit of buying finished forgings of outside concerns, and a third specification for the use of railroads and locomotive builders buying billets for the manufacture of forgings at their own works.

Proposed Specifications for Locomotive Driving and Engine Truck Axles.

Material..Open hearth steel

Chemical Requirements.

	Per cent.
Phosphorus, not to exceed	.05
Sulphur, not to exceed	.05
Manganese, not to exceed	.60

Physical Requirements.

Tensile strength not less than	80,000 lbs. per sq. in.
Elongation in 2 in., not less than	20 per cent.
Reduction in area, not less than	35 per cent.

One test per melt will be required, the test specimen to be taken from either end of any axle with a hollow drill, half way between the center and the outside, the hole made by the drill to be not more than 2 in. in diameter, nor more than 4½ in. deep. The standard turned test specimen, ½ in. in diameter and 2 in. gage length, shall be used to determine the physical properties.

Drillings or turnings from the tensile specimens shall be used to determine the chemical properties.

Each axle must have heat number and manufacturer's name, plainly stamped on one end, with stamps not less than ⅜ in., and have order number plainly marked with white lead.

All axles must be free from seams, pipes, and other defects, and must conform to drawings accompanying these specifications.

Axles must be rough-turned all over, with a flat-nosed tool, cut to exact length, have ends smoothly finished and centered with 60-deg. centers.

Axles failing to meet any of the above requirements, or which prove defective on machining, will be rejected.

The above specification for locomotive driving and truck axles is believed to be fair to both manufacturer and purchaser. The physical test outlined is one which should insure proper hammer work and it has also the following further points in its favor:

(1) It does not show the manufacturer which axle is to be selected for test.

(2) The axle tested is not destroyed, but is available for use if it meets the requirements.

(3) The test may be used in the purchase of small lots, most orders from railroad companies being for from six to ten axles.

(4) The test does not require a discard and in no way adds to the cost of the axle.

(5) It furnishes the manufacturer with a check of the work done in his plant.

(6) The test is one largely used by the United States Government for forgings.

Proposed Specifications for Locomotive Forgings.

Material..Open hearth steel

Chemical Requirements.

	Per cent.
Phosphorus, not to exceed	.05
Sulphur, not to exceed	.05
Manganese, not to exceed	.60

Physical Requirements.

Tensile strength, not less than	80,000 lbs. per sq. in.
Elongation, in 2 in., not less than	20 per cent.
Reduction in area, not less than	35 per cent.

One test per melt will be required, the test specimen to be cut cold from the forging, or full sized prolongation of same, parallel to the axis of the forging and halfway between the center and the outside.

The standard turned specimen, ½ in. in diameter and 2 in. gage length, shall be used to determine the physical properties. Drillings or turnings from the tensile specimen shall be used to determine the chemical properties.

Each forging must have heat number and name of manufacturer plainly stamped on one end with figures not less than ⅜ in. and have order number plainly marked with white lead.

All forgings must conform to drawings which accompany these specifications, and be free from seams, pipes and other defects.

Any forgings failing to meet any of the above requirements, or which prove defective on machining, will be rejected.

The above specification for locomotive forgings is based upon the recommendations of the American Society for Testing Material, with some slight modifications, which, it is believed, will tend to improve the product. The physical test is substantially the same as that recommended above for testing locomotive driving and truck axles, and the same arguments may be used in its favor.

Proposed Specifications for Steel Blooms and Billets for Locomotive Forgings.

Material..............................Open hearth steel

Physical Requirements.

Grade "A"—	
Tensile strength	70,000 lbs. per sq. in.
Elongation in 2 in.	20 per cent.
Grade "B"—	
Tensile strength	80,000 lbs. per. sq. in.
Elongation in 2 in.	17 per cent.

Chemical Analysis.

	Per cent.
Grade "A"—	
Carbon	.25 to .40
Phosphorus, not to exceed	.06
Sulphur, not to exceed	.06
Manganese, not to exceed	.60
Grade "B"—	
Carbon	.35 to .50
Phosphorus, not to exceed	.05
Sulphur, not to exceed	.05
Manganese, not to exceed	.60

One test per melt should be required, the test specimen to be cut cold from the bloom, parallel to its axis and halfway between the center and the outside. The standard turned test specimen, ½ in. in diameter and 2 in. gage length, shall be used to determine the physical properties. Drillings or turnings from the tensile specimen shall be used to determine the chemical properties.

Each bloom or billet must have heat number and manufacturer's name plainly stamped on one end, with stamps not less than ⅜ in. and have order number plainly marked with white lead.

Blooms and billets must be free from checks, pipes, and surface defects. Any blooms or billets chipped to a depth greater than ½ in. will be rejected.

Any billet or bloom failing to meet the above requirements will be rejected and held, subject to disposal by manufacturers.

Inspector to have the privilege of taking drillings from the center of the top bloom or billet of the ingot in order to determine the amount of segregation.

Grade "A" is blooms or billets for rod straps and miscellaneous forgings.

Grade "B" is blooms or billets for driving and truck axles, connecting rods, crank pins and guides.

The report is signed by Messrs. F. H. Clark, Chairman; J. E. Sague, S. M. Vauclain, L. R. Pomeroy.

EFFECTS OF TONNAGE RATINGS ON THE COST OF TRANSPORTATION.*

The superiority of the ton to the car as a unit of train rating is due not so much to the fact that it has a constant value as a unit of weight, as that it is a much more accurate measure of train resistance. Soon after its adoption the discovery was made that the ratio between train weight and train resistance is not constant, which led to a scientific investigation of the facts by means of dynamometer car tests. These showed that the greater the gross weight per car, the less the resistance per ton; that the heavier the adverse grade and the slower the speed the less this difference is. For example: It requires considerably less power per ton to haul a loaded 50-ton car than a loaded 25-ton car; at a speed of 20 miles an hour, on level track, a ton of empty car has a resistance 50 per cent. greater than a ton of loaded car, while on a 1 per cent. grade, at a speed of 10 miles an hour, the ton of empty car develops only about 7 per cent. more resistance than a ton of loaded car. These discoveries led to the adoption of adjusted tonnage ratings, which increase the nominal weight of empty, partly loaded and low capacity cars in proportion to their resistance per ton, so that the adjusted ratings more nearly approximate the resistance a train will develop than though the actual weights were used. There is little doubt that this refinement of the original plan of tonnage ratings has resulted in still farther reducing transportation costs.

Indirect savings in operating expenses, due to the use of tonnage ratings, are not always considered, for example, the use of the ton-mile basis for statistics, which naturally followed the introduction of tonnage ratings. Previously the almost universal basis of motive power statistics had been the engine-mile. Because the engines made more miles per ton of coal the lighter the train, there was a constant effort on the part of Master Mechanics and engineers to haul as light trains as possible in order to improve their records, which no doubt in a measure neutralized the efforts of the transportation department to handle as heavy trains as possible, and undoubtedly increased the cost of transportation, when compared with the possibilities, and was a source of constant friction between the two departments. The ton-mile basis for motive power statistics changed all this, because it was soon demonstrated that the heavier the train, within reasonable limits, the less the cost of coal, wages and repairs per ton-mile, and, therefore, it was to the interest of the motive power men to haul as heavy trains as practicable, thus harmonizing the interests and efforts of the employees of both the transportation and motive power departments. It would be impossible to say just what economy was produced by this change in the basis of motive power statistics, but it was real and considerable in gross amount.

The ton-mile basis also corrected a number of erroneous conclusions, resulting in a clearer understanding of cause and effect, which no doubt led to economies. A few illustrations will probably make this point plainer than an extended description. The figures given are actual records.

Table I.

	March, 1896.	1897.	Increase per cent.
Average miles per engine	2,282	2,289	0.3
Average ton-miles per engine	782,213	972,486	24

Without ton-mile statistics the conclusion would have been drawn that the average work done per engine, in the two years, was practically the same. The ton-mile figures show this conclusion would have been misleading, and also demonstrate that in this case the use of tonnage ratings increased the work done by the engines 24 per cent., as the class of locomotives was practically the same in the two years.

Table II.—Division D—January, 1896.

	Miles to ton of coal.		Coal per 100 ton-miles.	
	Lbs.	Per cent.	Lbs.	Per cent.
Main line, freight	16.6	100	20.79	100
Branch, freight	14.8	112	67.93	327
Main line, freight	16.6	193	20.79	100
Main line, passenger	32.1	100	33.09	159

On the engine-mile basis, the branch freight engines were using only 12 per cent. more coal than those on the main line. This record was considered satisfactory, so far as the branch was concerned, as there were a number of heavy grades and curves on it, while the main line was comparatively level and straight, and the conclusion was naturally drawn that it was not much more expensive, so far as fuel was concerned, to operate a mountain district than one on the prairie. The figures based on the ton-mile show that the heavy grades and curves of the branch required three and a quarter times as much coal as the main line to do the same amount of work.

In comparing the relative cost of fuel in freight and passenger service, using the engine-mile as a basis, the conclusion was that freight engines used nearly twice as much as passenger engines, but when the ton-mile was used it became evident that the cost of fuel was practically 60 per cent. greater in passenger service.

It would be impossible to show the saving resulting from these discoveries, but there were economies growing out of a more accurate knowledge of facts, a more intelligent reasoning from causes to effects and a conviction on the part of all concerned that the results were being studied and conclusions drawn on a fairer basis than formerly. An example of the effects of these influences is furnished by division B, of the road from the records of which the figures in Tables I and II are taken. There were three other divisions on this road. Most of the engines on division B were eight-wheelers and quite light, compared with the large engines on the other divisions. During the years 1895 and 1896, when compared on the engine-mile basis, the average cost of engine service on this division was 9 per cent. less than the average for the system, including B. This was largely due to the fact that the engines were comparatively light and handled relatively light trains. The use of the ton-mile basis for motive power statistics was begun in 1896 and showed the cost of engine service on division B was 13.6 per cent. greater than the average for the system. This resulted in twice increasing the tonnage ratings on this division. For the first six months of 1897 the average cost of engine service on division B was found to be only 1.2 per cent. higher than the average for the whole system, and this in spite of the fact that the average for the system had meanwhile decreased 9 per cent., as determined by the ton-mile unit. The result of the substitution of the ton for the car in rating locomotives, and the consequent use of the ton-mile basis for statistics, has been to increase operating efficiency and reduce the cost of transportation.

It is generally assumed that the maximum tonnage a locomotive can handle at a speed of about 10 miles an hour is the most economical. Considering the matter as applying to the conditions which have prevailed throughout the past winter, during which time there has existed practically a freight blockade, the paramount issue is to handle the business offered and keep it moving almost regardless of cost; in short, to handle the largest possible number of cars with the power and facilities available.

Table III applies to two divisions; the first 100 miles and the second 200 miles long, and is based on the following assumptions: First, that it requires four hours to get an engine from its train to the roundhouse, clean its fires, give it necessary repairs, furnish the necessary supplies and have it on its train again; second, that a train of 40 cars will allow an average speed of 10 miles an hour; third, that a reduction of the train from 40 to 35.2 cars, or 12 per cent., will permit an increase in the average speed to 15 miles an hour.

Table III.

	100-mile division.		200-mile division.	
Speed, miles per hour	10	15	10	15
Hours between terminals	10	6.67	20	13.32
Hours at terminal	4	4	4	4
Hours for one trip	14	10.67	24	17.32
Trips in 30 days	51.4	67.5	30	41.6
Cars hauled per trip	40	35.2	40	35.2
Cars hauled per month	2,056	2,376	1,200	1,464
Gain in cars handled per mo.	...	320	...	264
Gain in cars handled per month, per cent	...	16	...	22

These figures show an increase of from 16 to 22 per cent. in the number of cars an engine will handle per month due to a decrease of 12 per cent. in the number of cars handled per train, and that the longer the division the greater the increase. Some may question the fact that this reduction in tonnage rating will allow the increased speed claimed. Though there will be a greater number of trains to meet and pass because of the fewer cars per train, the lighter trains will not only make better time between stations, but will also lose very much less time waiting at stations for other trains, because the heavier train will frequently wait rather than take chances of making an advanced meeting point for lack of a few minutes. It seems likely the lighter trains will make even better running time between terminals than shown in the tables.

This conclusion was confirmed during a period covering a series of locomotive tests in heavy freight service, when the time lost waiting at stations for other trains frequently reached 45 per cent. of the total time between terminals. This was on a road which was single track for three-quarters of the distance over which the tests were made. If these conclusions are justified for a single track road, there would be less room for doubt on a road having two or more main line tracks, when there would be fewer trains to meet and pass.

When business is such that the locomotives available are insufficient to handle it, freight blockades are imminent, and when the tonnage ratings are such that speeds of 10 miles an hour or less are the result, the number of cars handled per locomotive per month can be considerably increased by reducing the tonnage ratings slightly, thus allowing an increase in the speed and increasing the efficiency of the engines.

As the number of cars handled per month can be increased by reducing the maximum tonnage ratings, it is possible this reduction of ratings may result in decreasing the cost per ton-mile, and this will probably be the result, at least during the seasons of unusually heavy business. It is almost inevitable that trains which have the maximum tonnage will much more frequently remain on sidings, rather than take chances of making advanced meeting points, than would be the case if the tonnage were somewhat smaller, because the chances of the heavier trains breaking in two on pulling out of sidings, of their failing to make a meeting or passing point against a superior train because of bad weather conditions or dragging brakes, are much greater than their larger tonnage would indicate at first glance. The wages paid for overtime and the cost of fuel wasted on side tracks and in taking and leaving sidings, and the cost of car and engine repairs are probably more than proportionally greater for the heavier tonnage. Unfortunately it is nearly impossible to obtain accurate statistics to show whether this conclusion is warranted or not.

The following figures give the percentages of overtime paid engineers and firemen, in relation to their total wages, during June, when there was no special rush of business and the engines available were ample to handle it easily, and during September, when the power was taxed to its utmost capacity.

	Div. A.	Div. B.
June—Overtime, per cent. of total wages	1.8	2.0
September—Overtime, per cent. of total wages	5.3	4.6

This shows that the overtime paid increased from two to three times as much as the business done, as determined by the wages paid enginemen. It does not follow that all the increased percentage of overtime was due to maximum tonnage ratings, but had the tonnage ratings been moderately reduced, the increase in overtime would not have been so much heavier than the increase in business done, and it seems a fair inference that the cost of wages for train and engine crews, and to this extent the cost of transportation, was heavier per ton with the maximum ratings than though these had been reduced so as to allow a somewhat higher average speed.

The reasons which make it seem probable that a reduction of maximum tonnage ratings would decrease the cost of wages per ton-mile apply with equal force to the cost of fuel; not that the cost of fuel while running would be much, if any, greater per ton-mile with the maximum tonnage, but that the longer delays on side tracks, the longer hours for the train and engine crews and the damage done the fire while pulling out of side tracks with the heaviest trains would result in a greater cost of fuel per ton-mile. As to which cost, wages or fuel, would be increased the greater amount would depend on the cost of fuel and the conditions for which overtime is paid. Some data is at hand which clearly indicates a saving in fuel by reducing somewhat the maximum tonnage ratings, but unfortunately the average speeds, average weight per car and other items are lacking, which make a conclusion drawn from these records but little better than an opinion.

In this connection in an article in the *Railway Age* by Mr. William Bennett the following table is given.

Maximum Load.

45 cars bituminous coal, gross tons		1,935
45 cars bituminous coal, net tons		1,215
Wages of train and enginemen, 22 hours at $1.35		$29.70
Coal consumed, 17 tons at $2.87		48.79
Cost of hauling, per ton of coal, wages	$2.45	
Cost of hauling, per ton of coal, fuel	4.01	
Total	——	$6.46

The Same Train Reduced Five Cars.

40 loaded cars, bituminous coal, gross tons		1,720
40 loaded cars, bituminous coal, net tons		1,080
Wages of train and enginemen, 17 hours at $1.35		$22.95
Coal consumed, 9 tons at $2.87		25.83
Cost of hauling, per ton of coal, wages	$2.13	
Cost of hauling, per ton of coal, fuel	2.39	
Total	——	$4.52

These figures show that a reduction of 11 per cent. in

*Extracts from a paper read at the 1903 meeting of the American Railway Master Mechanics' Association by C. H. Quereau, Supt. Shops., N. Y. C. & H. R.

the tonnage increased the average speed between terminals 30 per cent.; decreased the cost of wages 13 per cent., of fuel 40 per cent., and the total cost of wages and fuel 30 per cent. per ton of net load. If to this saving in wages and fuel is added the larger number of tons the engine handles per month, because it is on the road five hours less per trip with the reduced tonnage, a very respectable showing is made for the reduced tonnage. The average saving under general service conditions will not be as much as shown above, but if it is only 10 per cent. or even 5 per cent., it represents a saving and increased efficiency which is worth serious consideration and investigation.

In the issue of the *Railroad Gazette* for March 2, 1900, is an interesting and valuable article giving the results of a series of elaborate tests made to determine the most economical rate of speed for freight trains on the Northern Pacific. These were found to vary from 12 to 18 miles an hour, according to the class of engine and the varying conditions on the different divisions; the average being 15.4 miles an hour.

The discussion and facts given warrant the conclusion that tonnage ratings which limit the average speed of freight trains to 10 miles an hour, or less, result in a greater cost of transportation and decreased earning power for motive power than ratings which allow a somewhat higher speed. It follows that such maximum tonnage ratings produce a higher cost of transportation than is necessary and that the subject is well worth extended, careful and scientific investigation.

The adoption of tonnage ratings for freight trains has reduced the cost of transportation by increasing the average trainload; by reducing the cases of doubling and overtime; by furnishing a basis of common interest for the operating and motive power departments to handle full trains, and by furnishing a fairer basis for judging operating and motive power efficiency.

As is usual when any new plan has proved beneficial, the pendulum has swung to the opposite extreme and the maximum tonnage ratings are, as a rule, greater than the most economical ratings.

Electrically Driven Woodworking Machines.

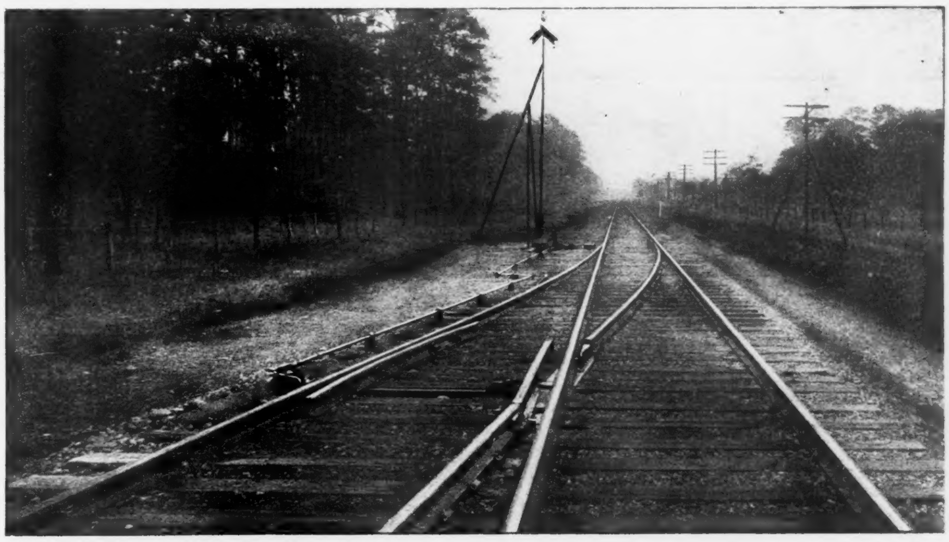
The installation of electric motor drives in groups or on individual tools has come to be considered an essential feature of the modern machine shop. The arguments in favor of this system of power distribution over a system of belts and shafting for machine tools apply with equal force to woodworking tools. The progressive makers of this class of machines have devoted much time and money to designing and building machines especially adapted to motor driving, realizing the great advantages to be gained by the electrical transmission of power. Briefly summed up these are: 1st. Saving of power. 2nd. Decreased cost of maintenance. 3. Increased output. 4th. Convenience and flexibility. 5th. Sanitary improvement and safety. The question of speed control, so essential in any installation for machine tools, is not so important a consideration for woodworking machines since they are usually designed for one speed, but on the other hand the variation in power required to drive is very great depending on the depth of cut, condition of the cutting edges, rate of speed and kind of material worked, and this is not so true for machine tools in which the cutting speed increases as the tool resistance decreases.

The S. A. Woods Co., Boston, Mass., during the last few years has paid special attention to the question of electrically driven woodworking tools in order to determine exactly what the saving over belts and shafting is. Exhaustive tests in a large number of shops have convinced the company that the motor drive is superior in every way to the belt and shafting system, and it is now building a line of machines equipped with specially designed motors and built to conform to motor speeds. Some of these are shown in the accompanying illustrations. Fig. 1 is a heavy timber sizer and car sill planer with a direct connected semi-enclosed motor, mounted on the floor next to the machine. It will take stock up to 30 in. wide by 24 in. thick, and is run at 1,000 r.p.m. Fig. 2 is a vertical hollow chisel mortiser driven by a belt from the motor supported overhead. The spindle is run at 800 r. p. m. and a 15 or 20 h.p. motor is recommended. Fig. 3 is a multiple spindle borer driven by a motor mounted on the floor back of the machine through a belt passing around the main spindle and a pulley on the armature shaft. A 7½ h.p. shunt wound motor is used and the spindle is run at about 300 r.p.m. Other arrangements than those shown can be used when necessary or similar machines may be grouped together and run from one countershaft.

The saving of power is a factor of highest importance in considering the relative advantages of any system of driving for woodworking shops. Tests have shown instances where 83 per cent. of the power developed in the engine room was dissipated by the belts and shafting with all machines at full load and at no time was the efficiency higher than 30 per cent. This is perhaps an exceptional case, but shows the possibilities of loss through loose belts, imperfect alinement of shafting and friction in the bearings due to neglect in oiling and the accumulation of dirt and grit always found in a shop. Woodworking machines are always driven at high speeds and the amount of power required fluctuates greatly with the conditions of the work, in some cases a difference of 300 per cent. has been found due simply to the condition of the knives. When a large amount of power is transmitted at high speeds through belts and shafts the losses are very great as compared with the losses in a system of electrical transmission.

While the motor drive system may be more expensive to install, the decreased cost of maintenance more than compensates for the first cost. With no shafting to lubricate, no belts to renew or repair and no trouble from loose pulleys, there is no difficulty in keeping the machines running and the men productively employed. Actual returns from plants now operated by electricity show that the output has been increased from 10 to 30 per cent.

Perhaps the greatest advantage of electricity over belts and shafting is the flexibility of the entire system. With a certain location of the line shaft or jack shaft, a machine must be mounted in a definite position regardless of the arrangement of floor space or the convenience of operation. With the motor drive a tool may be located without regard to the source of power, all the floor space made available and any section of the plant operated independently of the rest. When running overtime this is almost a necessity. By doing away with the overhead shafting, traveling cranes can be installed and the work economically handled to and from the machine. The removal of belting and shafts eliminates a constant source of danger to the men and makes a great improvement in the sanitary conditions of the shops by giving more light and preventing the constant agitation of grease-laden dust in the air by the rapidly moving belts.



Coughlin Swing Rail Frog—Louisville & Nashville Railroad.

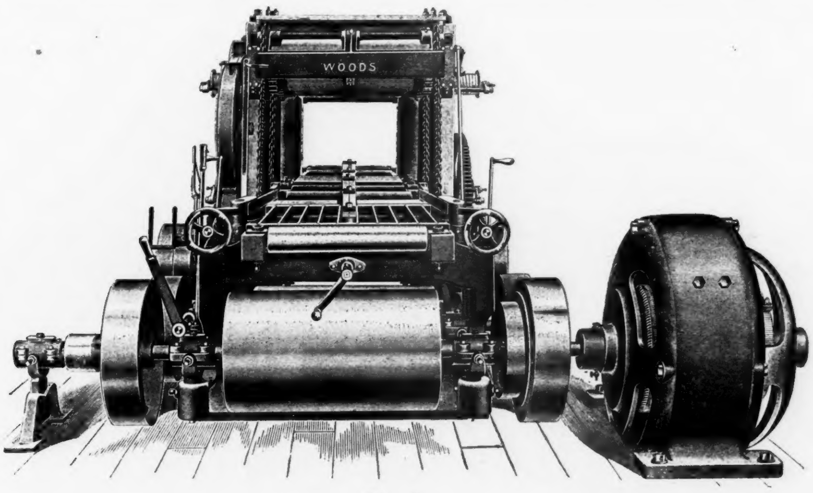


Fig. 1.

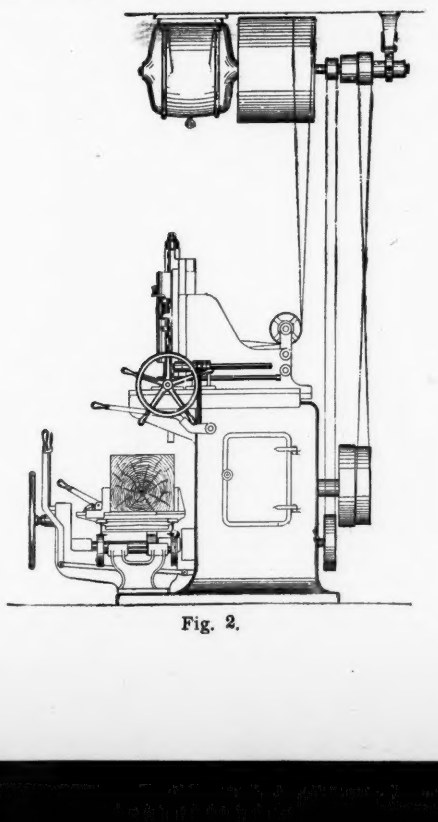


Fig. 2.

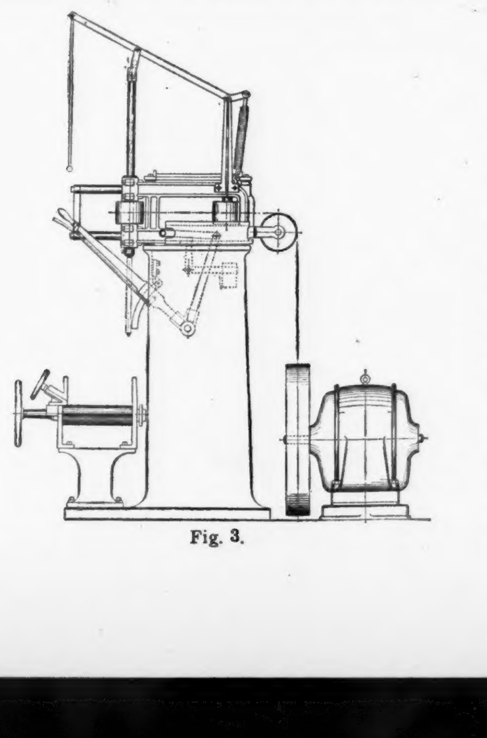


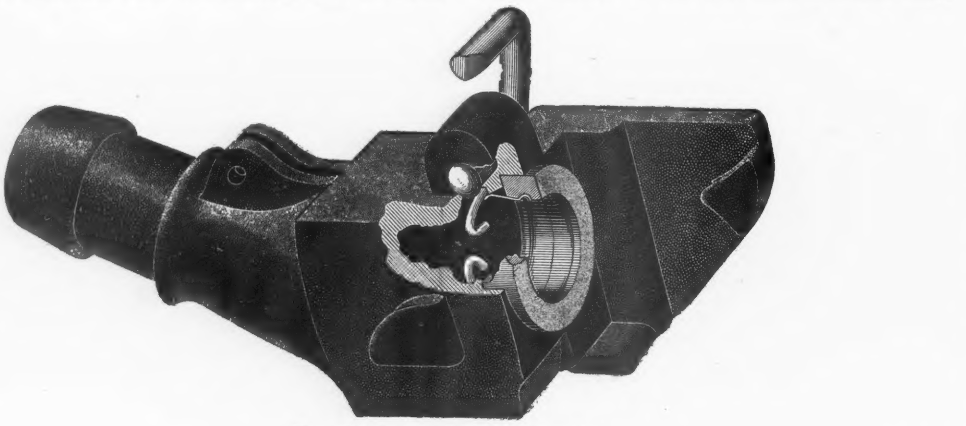
Fig. 3.

The Coughlin Swing-Rail Frog.

On Dec. 9, 1898, in these columns was shown the Coughlin frog as used on the Lehigh Valley road. The engraving herewith shows an installation on the Louisville & Nashville, where similar frogs have been used for many years. It will be seen that the main line rail is continuous. The movable frog consists of two principal parts; the base, or fixed section, and the movable, or swing section. The base section, having a heavy base plate countersunk into the ties and extending beneath the main rail, is securely connected to the ends of the fixed lead rails, and serves to hold these parts rigidly in position, and also forms a suitable support or foundation for the swing section, which is pivoted to it by means of a substantial hinge. The swing section is also locked from vertical motion, being held down to the base plate by a heavy clamp attached about midway. The swing section is made of rail, of a height that carries the wheels 1¾ in. above the main rail, allowing ample flange way. We are informed that the Coughlin-Sanford Switch Company, 25 Broad street, New York, is installing many of these frogs on a number of roads. In connection with it the company uses the automatic detector switch lock, which was illustrated in these columns last week.

A New Safety Straight Port Steam Coupler.

The Safety Car Heating & Lighting Company has recently brought out an improved form of its straight port coupler, which gives an unrestricted passage from the locomotive to the end of the train for the steam used in car heating. The new coupler, which has no larger head than the old style of coupler, may be coupled to the old type through the use of a metal disk which is fitted over the gasket with the larger opening. A simple method is employed for holding the gasket in the coupler and a worn-out gasket may be removed and a new one inserted without the use of any special tool or the necessity of taking apart the coupler. The gasket is locked in the coupler by a spring which is a part of the complete gasket. The ends of this spring are turned in, and by pulling them together and then pulling slightly on the gasket the gasket is easily removed. To apply a new gasket, all that is necessary is a slight tap of the hand after the gasket has been put in the recess. This lock is positive and the gasket cannot be lost; at the same time, the changing of the gasket is a comparatively simple and inexpensive matter. A means of locking two couplers together is provided, when it is desirable to do so. This lock is located directly over the center line of the gasket and operates in such a way that there is no tendency for the couplers to twist apart. While it does not interfere in any way with the making of the coupling, it prevents the opening of the couplers on sharp curves, due to stiff hose or incorrect location of the train pipe. Guiding lugs have been added to the couplers, which facilitate coupling and cause the gaskets to come together squarely and in line. If it is desired to provide for the automatic breaking of the coupling, these lugs make positive the automatic disengaging of the two couplers. The port opening is made either $1\frac{7}{16}$ in. in diameter, permitting the use of $1\frac{1}{2}$ in. hose, or with a full $1\frac{1}{2}$ in. opening. This new type of coupler is known as No. 920. It is shown in the engraving.



New Safety Straight Port Coupler.

Exhibits at the Saratoga Conventions.

The number of exhibits this year is about the same as for the past two years. The usual number of spaces has been allotted on the verandas of the Grand Union Hotel, but the out-of-door exhibits, instead of occupying the usual place on the lawn, are further back in the space between the lawn and the rear fence of the grounds. A number of the prominent exhibits have been late in arriving, due possibly to the change of meeting place after all arrangements had been made for Mackinac Island. Following is the list of exhibits on the ground up to Wednesday morning; those placed subsequent to that time will be given next week:

Acme Railway Supply Co., Chicago.—Sample Acme vestibule diaphragm.

The Adams & Westlake Co., Chicago.—Large, handsome pavilion in cream and gold surmounted by gilded dome studded with 2,000 2-in. glass bull's-eyes and 30 8-in. glass bull's-eyes; the whole lighted by 118 acetylene gas lamps supplied from five Adlake generators. Also within the pavilion were the various kinds of car fixtures and chandeliers for acetylene lighting, and two Adlake generators for exhibition purposes.

American Automatic Lubricator Co., New York City.—Working model showing the action of an automatic lubricator in the form of a small pump placed between the bottom of the journal bearing and the box which pumps oil from the bottom of the box to the under side of the bearing. The pump is actuated by the relative movement of the box and journal.

American Brake-Shoe & Foundry Co., New York City.—Samples of the different types and styles of brake-shoes made by this company.

American Car & Foundry Co., Chicago.—Full-size sample Fowler solid rolled-steel car wheel; test wheel cut to show condensation of metal after rolling.

American Machinery Co., Grand Rapids, Mich.—Samples of Oliver hand jointer, saw bench, wood trimmers and wood lathes.

American Steam Gage & Valve Mfg. Co., Jamaica Plain, Boston, Mass.—Locomotive steam gages, locomotive pop safety valves (muffled and open), American-Thompson improved steam engine indicator, recording gages, chime whistles, test pumps and locomotive water gages.

American Steel Foundries, New York City.—Photographs and wash drawings of the output of the company including the Player, Ajax, American and Keystone trucks, and of miscellaneous trucks and body bolsters, double cast steel body bolsters for passenger cars, Davis and Crescent driving wheel centers.

The Anti-Bursting Pipe Co., Washington, D. C.—Full size working models showing the application of a device for preventing the bursting of pipes by freezing. The device consists of a small air reservoir for taking up the expansion of the water in freezing.

Armstrong Brothers Tool Co., Chicago.—Tool holders for lathes, planers and slotting machines, universal ratchets, planer jacks and lathe dogs.

Ashcroft Mfg. Co., New York City.—Steam, air-brake, ammonia, hydraulic and test gages, Edison recording gage and steam engine indicators.

Aurora Metal Co., Aurora, Ill.—Samples of Lewis & Kunzer metallic piston packing. Full-size gland and rod showing application.

Baltimore Railway Specialty Co., Baltimore, Md.—Samples of Norwood ball bearing center plates and side bearings.

Charles H. Besly & Co., Chicago.—Sample No. 40 motor-driven, direct connected Gardner emery grinder.

Bethlehem Steel Co., South Bethlehem, Pa.—Nickel steel and carbon steel locomotive forgings and castings, special staybolt iron, high manganese foundry pig iron. Taylor White tool steel, malleable manganese bronze castings, aluminum castings, forgings and shafting for stationary and marine engines, rapid fire gun mount, nickel steel rifle-barrels, projectiles, shells and cement grinding balls. Also for the Shelby Steel Tube Company, Pittsburg, Pa., non-corrosive boiler and condenser tubes of all diameters and gages, made of "Bethlehem" 30 per cent. nickel steel and for the Orford Copper Company, New York City, blocks of metallic nickel.

Bitner Car Equipment Co., Terre Haute, Ind.—Full-size working model of car door equipped with the Bitner locking device.

The D. W. Bosley Co., Chicago.—Full-size model showing car window frames equipped with metallic weather strips.

Boston Artificial Leather Co., New York City.—Car seats upholstered with "Moroccoline."

Buckeye Malleable Iron & Coupler Co., Columbus, Ohio.—Sample "Major" coupler, mounted to show operation. Coupler knocked down to show detail parts.

Buffalo Forge Co., Buffalo, N. Y.—A Buffalo "N. R. R." electric driven down draft forge. Also a fine wash drawing of a section of a Buffalo Forge Co. tandem compound engine.

The Carborundum Co., Niagara Falls, N. Y.—Cases containing carborundum products, carborundum wheels, stones, etc.

The Celluloid Co., New York City.—Samples of "Texoderm" for upholstering and car curtains.

L. C. Chase & Co., (Sanford Mills), Boston, Mass.—A full line of samples of mohair plush for upholstering car seats, also "Chase Leather" (an imitation leather) for upholstering and car curtains.

Chicago Car Heating Co., Chicago.—Car heating apparatus under steam.

Chicago Pneumatic Co., Chicago.—Sample line of Boyer pneumatic hammers, Boyer and "Little Giant" piston air drills; yoke riveter and pneumatic painting machine.

Chicago Railway Equipment Co., Chicago.—Samples of the National-Hollow, Kewanee, Diamond, Monarch Solid, Ninety-six, and Sterlingworth brake-beams; and of automatic frictionless side-bearings. Full-size working model of the "Creco" slack adjuster, a new device.

Consolidated Car Heating Co., Albany, N. Y.—Full line of car heating apparatus, including Sewall and Consolidated couplers, steam traps, steam drums and valves.

Consolidated Safety Valve Co., New York City.—Muffler and open top safety valves.

W. W. Converse & Co., Palmer, Mass.—Samples of headlight polish.

The Crocker-Wheeler Co., Ampere, N. J.—Artistic catalogue describing the new shops of the Lake Shore at Collinwood, Ohio, which shops are equipped with the Crocker-Wheeler system for driving machine tools. Also bound photographs of recent motor driven machine tools.

Crosby Steam Gage & Valve Mfg. Co., Boston, Mass.—Recording gages, steam and hydraulic gages, safety valves, locomotive chime whistles, globe, angle and gate valves, muffled pop safety valves and a large model of the "Crosby" globe valve.

The Curtain Supply Co., Chicago.—Cozy corner on veranda furnished in Oriental style with four-frame stand equipped with Burrowes and Forsyth types of "Roller Tip" curtain fixtures.

Economy Car Heating Co., Portland, Maine.—Full-size Robinson exhaust nozzle and full-size model of car door with Kanaly door hanger.

Economy Locomotive Sander Co., Baltimore, Md.—Exhibit of locomotive sanders in operation.

The O. M. Edwards Co., Syracuse, N. Y.—Seven models of window fixtures and six models of automatic extension platform trap doors.

The Fabrikoid Co., Newburg, N. Y.—Samples of "Fabrikoid" leather for upholstering and curtains.

The J. A. Fay & Egan Co., Cincinnati, O.—Sample of heavy band ripping saw. Pictures of wood-working machinery.

Federal Mfg. Co., Cleveland, O.—Working models of Keeler curtain fixtures. These fixtures were described in the *Railroad Gazette* June 19, page 443.

Federal Supply Co., Chicago.—Small working models of the Robinson ash and cinder conveyor, the Toltz automatic ash-pan, and samples of steel wool.

Forsyth Automatic Air & Steam Coupler Co., Chicago.—The Forsyth automatic air and steam coupling mounted on special model trucks to show operation.

Forsyth Bros. Co., Chicago.—Samples of the Forsyth draw-bar centering device, and of Forsyth deck-sash ratchets.

Garry Iron & Steel Co., Cleveland, O.—Full-size working model "Form C" pneumatic crane, 2,000 lbs. capacity, mounted on car on standard-gage track. One-ton drop-bottom coal bucket. Dolly-bar. Pneumatic car jack with carrying truck; pneumatic painting machine.

General Manifold Co., Franklin, Pa.—Samples of railroad telegraph blanks, bills of lading, etc., with carbon backs, for duplicating.

The Gold Car Heating & Lighting Co., New York City.—A complete car heating system in operation. Also samples of the Gold electric heaters.

The Gould Coupler Co.—Roller side-bearings, trap-doors, journal boxes, tender and freight couplers and friction draft gear.

Hancock Inspirator Co., New York City.—Inspirators, ejectors, strainers, boiler washers, special steam valves and double checks with stop valves for locomotive use.

Handy Car Equipment Co., Chicago.—Full-size locomotive pilot equipped with the Handy horizontally-swinging pilot coupler. Samples of the Snow wrecking frogs.

The N. L. Hayden Mfg. Co., Columbus, O.—Samples of Downing metallic packing and the Tippet compact safety valve.

The Hale & Kilburn Co., Philadelphia, Pa.—Car seats.

Heywood Brothers & Wakefield Co., Wakefield, Mass.—Car seats and parlor car chairs.

Home Rubber Co., Trenton, N. J.—Samples of "N. B. O." packing, steam hose, air hose and tubular gaskets.

Homestead Valve Mfg. Co., Pittsburg, Pa.—A large gilt model of the Homestead locomotive blow-off valve. Also samples.

Illinois Malleable Iron Co., Chicago.—Small working model of the Bruyn automatic swinging smoke-jack.

Ingersoll-Sergeant Drill Co., New York.—Samples of the Haeseler "Axial Valve," pneumatic chipping and riveting hammers, pneumatic drilling machines; also an improved quick acting hose coupling.

International Correspondence Schools, Scranton, Pa.—Exhibit designed to show their correspondence course in railroad engineering.

Jenkins Brothers, New York City.—A full line of globe, angle and check valves, Glauber water gages, Jenkins 96 packing, pump valves and discs and gasket tubing.

The H. W. Johns-Manville Co., New York City.—Easel containing samples of asbestos and magnesia products; also roofing and building materials, steam packings, Vulcabeston, moulded mica, fire-proof cements, boiler and pipe coverings, etc.

Philips Justice & Co., Philadelphia.—A model of the yacht "Reliance," together with samples of the "Reliance" jacks.

The Kennicott Water Softener Co., Chicago.—Large photographs of Kennicott water softening plants installed on railroads, mounted on a revolving device moved by clock-work.

Lawson Boat & Car Co., New York.—Small working model of steel dump car operated by compressed air.

Macleod & Co., Cincinnati, O.—Sample "Buckeye" light.

Manning, Maxwell & Moore, New York City.—Appliances made by Ashcroft Mfg. Co., Consolidated Safety Valve Co., Hancock Inspirator Co., and Metropolitan Injector Co.

Manufacturers' Railway Supply Co., Chicago.—Samples of the "Interlocking" car and driver brake-shoe and driver brake-head.

The Mason Regulator Co., Boston, Mass.—Steam specialties.

Metal Plated Car & Lumber Co., New York City.—Samples showing method of applying copper sheathing to wood strips for passenger car work.

Metropolitan Injector Co., New York City.—Injectors, ejectors, water heaters and hose strainers.

Michigan Lubricator Co., Detroit, Mich.—A new triple sight-feed lubricator with automatic safety device to prevent injury from blowing out of glasses; also a new glass may be put in and filled with water without closing throttle or interfering with any of the other feeds.

The Midland Supply Co., Chicago.—Samples of the Perry roller side-bearing and of the spiral journal-bearing.

Moran Flexible Joint Co., Louisville, Ky.—Samples of Moran flexible ball and pivot joints and steam couplings; and ball and pivot liquid joints. Ball joint samples ranged from ⅛ in. to 24 in.

The National Lock Washer Co., Newark, N. J.—Full-size models of curtain fixtures, sash locks and sash balances and lock washers.

New Jersey Car Spring & Rubber Co., Jersey City, N. J.—Samples of rubber goods for railroad purposes.

A. O. Norton, Boston, Mass.—Ball-bearing lifting jacks, journal, bridge and track jacks.

Orford Copper Co., New York City.—Blocks of metallic nickel.

Pantasote Co., New York City.—Model of section of a passenger car showing seats and curtains of "Pantasote" leather.

Philadelphia Pneumatic Tool Co., Philadelphia, Pa.—Chipping hammers, flue beading hammers, holders on, calking hammers, rotary drills, foundry reamers, riveting hammers, yoke riveters and concrete tampers.

The Piper Draft Gear Co., Cleveland, O.—Full-size samples of the Piper friction draft gear Nos. 1, 2, 3 and 4.

Pittsburg Spring & Steel Co., Pittsburg, Pa.—Samples of elliptic and spiral car and locomotive springs.

Pyle-National Electric Headlight Co., Chicago.—Sample electric headlight equipment. Commercial Acetylene Co.'s safety storage system for lighting, showing 3,500-ft. holder supplying 20 ½-ft. lights, with complete equipment for a car. Also six 78-ft. holders with two ½-ft. burners each distributed around the verandas. Fully equipped D., L. & W. car on D. & H. tracks.

Rand Drill Co., New York City.—Three methods of compressing air are shown, namely: By steam, by electricity and by gas driven machines respectively. The steam outfit consists of a Rand Imperial type 10, 9-in. x 12-in. steam, 14-in. and 9-in. x 12-in. air, having a capacity of 1,370 cu. ft. a minute. The motor driven machine is a standard 6 in. x 8-in. Imperial type 11, having a capacity of 51 cu. ft. and fitted with a Rand pressure regulator. A Rand Imperial type 11, compressor is belt driven from an Otto gas engine to which is connected an Imperial air unloader. A complete

line of pneumatic tools is shown in operation including piston motor chain hoists, long stroke riveting hammers and chippers and piston air drills. Also reversible reaming, tapping and flue caulking machines and wood boring machines. A piston air breast drill is also shown. A tool of each type is shown in operation, the rivets being heated in a Rockwell Engine Co.'s gas rivet heating forge.

Railway Appliances Co., Chicago.—Full-size samples of the Stanwood car step, Ajax vestibule diaphragm, Symington journal box and dust-guard, Globe ventilator and Whall metallic window casing; also photographs of pneumatic tools, power and shop saws and the Priest snow flanger.

Republic Railway Appliance Co., St. Louis, Mo.—Republic friction draft gear, Dexter brake-beams, Symington journal box and dust-guard, "Interlocking" car and driver brake-shoe and driver brake-head, Monongahela locomotive tubes, "Falls Hollow" staybolt iron, Flatau's paint, and St. Louis Surfacer Co.'s products.

Robins Conveying Belt Co., New York City. Model of the Robins belt conveyor for handling all kinds of material and fitted with Richardson automatic scales.

Safety Car Heating & Lighting Co.—Booth showing various designs of overhead and bracket Pintsch gas lights. This exhibit occupied a prominent place in the corridor of the Grand Union Hotel.

Shelby Steel Tube Co., Pittsburg, Pa. Non-corrosive boiler and condenser tubes of all diameters and gages made of "Bethlehem" 30 per cent. nickel steel.

Simplex Railway Appliance Co., Chicago.—Samples of "Simplex" 100,000, 80,000 and 60,000-lbs. capacity body and truck bolsters and "Simplex" I-beam tender truck bolster; also "Simplex" brake-beams for all service, and "Susemihl" roller side-bearings for freight and passenger equipment.

Soule Raw Hide Lined Dust Guard Co., Boston, Mass.—Samples of the Soule raw hide lined dust-guard.

Standard Coupler Co., New York City.—Standard steel platform, Sessions Standard friction draft gear and Standard couplers.

Storrs Mica Co., Owego, N. Y.—Mica headlight chimneys and lantern globes.

Stromberg-Carlson Telephone Mfg. Co., Chicago.—Exhibit of apparatus for railroad telephone systems.

The T. H. Symington Co., Baltimore, Md.—Samples of the Symington patent journal boxes and dust-guards; also a full-size working model driven by a G. E. motor showing the comparative action of the waste and oil in the Symington and standard M. C. B. journal boxes.

J. Spencer Turner Co., New York City.—A line of "Jesteko" imitation leather for car seats and upholstering; also "Outarite" and "Water Tight" cotton ducks for car roofs.

U. S. Metal & Mfg. Co., New York City.—Combination steel draft rigging and under-frame, U. S. steel truck, Johnson hopper door, flush box car door, refrigerator door, drop gondola door and National adjustable bearing.

Vulcan Iron Works, Toledo, O.—A case of photographs showing the "Giant" steam shovels in operation.

Walworth Mfg. Co., Boston, Mass.—Locomotive injectors, wrenches, pipe cutters, steam whistles, stocks and dies, pipe vises, taps and cutters and Smith's track ratchet.

Waycott Supply Co., St. Louis, Mo.—Samples of the "Damascus" brake-beam.

West Disinfectant Co., New York City.—Samples of chloro-naptholeum, Taussig automatic disinfector and the Protectus disinfector.

Western Tube Co., Kewanee, Ill.—Samples of "Kewanee" brass and iron ball-joint unions from ½ in. to 3 in.

H. B. Wiggin's Sons Co., Bloomfield, N. J.—Samples of Fat-Ri-Ko-Na woven wall coverings and Ko-Na-Colors for decorative work and for wood stains.

Wilmarth & Morman Co., Grand Rapids, Mich.—Three sample styles of "New Yankee" drill grinders.

Wisconsin Graphite Co., Pittsburg, Pa.—Samples of various grades of graphite and ready mixed paints, automobile lubricant, etc.

Yale & Towne Mfg. Co., New York City.—Full-size model of door and casing fitted with the "Blount" door check and spring; also samples of different styles of "Blount" checks.

Meeting of Baltimore & Ohio Officials at Deer Park.

The spring meeting of the officers of the Operating Department of the Baltimore & Ohio Railroad was held at the company's Deer Park Hotel, in the mountains of Western Maryland, on June 15 and 16, under the chairmanship of Mr. C. S. Sims, General Manager. There were present about two hundred of the officers and employees of the railroad, including general officers, superintendents, engineers, supervisors of signals and division agents, as well as a number of agents from principal points.

On the morning of the 15th there was a series of short addresses by officers of the railroad, which were followed by discussion. Mr. L. G. Haas, Assistant General Manager, spoke on the "Division Engineer, His Duties and Opportunities," laying special stress on correct design of yards. Mr. J. E. Muhlfeld, General Superintendent of Motive Power, spoke on "The Work Before the Motive Power Department," and especially what should be done to get the engines in shape for next winter and keep them in shape through the winter.

Mr. W. H. Williams, Assistant to the General Manager, spoke on "The Duties of the Division Agent." Officers with this title have been appointed on the more important divisions of the B. & O. to supervise the work of the agents. Mr. M. L. Byers, Assistant to the General Manager, spoke on "Train Loading and Over-time, and the records and methods necessary to increase the train loading without at the same time increasing the over-time."

Mr. Arthur Hale, General Superintendent of Transportation, spoke on a "Car Supply," making the point that cars should be furnished shippers only when there is reasonable assurance that they will be promptly loaded, promptly moved and promptly unloaded. The meeting was closed by an address by the veteran Consulting Engineer, Mr. David Lee, who spoke tenderly of the past and hopefully of the future of the railroad.

In the afternoon a meeting of the division agents and agents was held, under the chairmanship of Mr. W. H. Williams, to consider the introduction at principal points of the "mani-bill," a way-bill so printed that with the use of carbon sheets a single writing, with type-writer, will produce a way-bill, an expense bill, and receipts and other copies of the same document, if necessary. In the afternoon there was also a game of baseball between the Engineering and the Signaling Departments; and the tennis courts, bowling alleys and swimming pool were well patronized.

On the morning of the 16th, Mr. Houston Lowe, President of The Lowe Brothers Paint Company, Dayton, Ohio, read a careful paper on "Paints and Painting," and showed a number of sample panels, which had been exposed to the weather, and films of oil and paint, illustrative of good and bad mixing and application.

His paper was followed by shorter addresses by Mr. J. E. Greiner, Engineer of Bridges and Buildings; Mr. E. H. Bankard, Purchasing Agent, and Mr. W. M. Greene, Vice-President and General Manager of the Baltimore & Ohio Southwestern.

This was the fourth of these meetings of B. & O. officers. The first was held at Cumberland two years ago, but the meetings since then have all been at Deer Park Hotel, and have been held just before and after the regular hotel season. These meetings largely take the place of the annual inspections and the officers' associations, which are kept up on the Pennsylvania and other railroads.

TECHNICAL.

Manufacturing and Business.

D. A. Campbell, who for several years was connected with the Columbia Refining Co., of New York, is now associated with the More-Jones Brass & Metal Co., St. Louis.

L. K. Sherman has resigned from the Bridge Department of the Atchison, Topeka & Santa Fe R. R., to take the position of Engineer for the Geisel Construction Co., Koken Building, St. Louis, Mo.

H. H. Kingston, who has recently been elected President of the Investment Co. of Philadelphia, is about to retire from his present position of General Traffic Manager of the Lehigh Valley R. R.

The Independent Railroad Supply Co., The Rookery, Chicago, has just finished an order for 23 carloads of tie-plates for the Grand Rapids & Indiana. The company has a large order for tie-plates from the Buffalo, Rochester & Pittsburgh.

H. B. Underwood & Co., 1025 Hamilton street, Philadelphia, makers of special tools for railroad repair shops, have doubled the capacity of their shop by building an addition 125 ft. long. A number of large tools have also been recently installed.

Stephen W. Baldwin, who for 20 years has represented the Pennsylvania Steel Co. in New York as sales agent, will retire from active service on July 1, although he will remain with the company in an advisory capacity. A. E. Aeby will succeed Mr. Baldwin.

The Falls Hollow Staybolt Company have opened an office at 132 Nassau street, New York, for the sale of their hollow and solid staybolt iron. The office is in charge of Mr. Fred F. Bennett, who also represents C. B. Hutchins & Sons, Detroit, Mich., manufacturers of freight car roofs and roofing materials.

The Railway Safety Signal Company has been incorporated in New Jersey, with a capital stock of $500,000 by William H. Brown, Julian W. Curtiss and Frank Eveland, all of 52 Madison avenue, Jersey City, N. J. The company will make and install electric, pneumatic and other signals. Also to make frogs, switches, etc.

The Knitted Mattress Co., Canton Junction, Mass., reports an increasing demand for its knitted elastic padding for upholstering car seats. The principal claims made by the company are that because of the ease with which the material can be handled, seven seats can be upholstered as quickly as one with any other material, and that the elastic padding is superior to curled hair.

A certificate of the consolidation of the Ramapo Iron Works of Hillburn, and the MacPherson Switch & Frog Co., of Niagara Falls, under the name of the Ramapo Iron Works, has been filed at Albany, N. Y. The total capital of the combined companies is $1,400,000. W. W. Snow and R. J. Davidson, Hillburn; Wm. B. Rankin, Niagara Falls, and J. M. Van Winkle, Bloomfield, N. J., are directors.

At a meeting of the Board of Directors of the Safety Car Heating & Lighting Co., June 10, the following officers were elected for the ensuing year: Robert Andrews, President; R. M. Dixon, Vice-President; D. W. Pye, Second Vice-President; C. H. Wardwell, Secretary and Treasurer; I. P. Lawton, Assistant Secretary and Treasurer. At the same meeting the regular quarterly dividend of 2 per cent. and an extra dividend of 1 per cent. were declared. This dividend will be payable July 1. The annual report of the company showed that the past year had been very prosperous, both in the lighting and heating departments, and the prospect for the coming year was bright. Further facilities for the supply of Pintsch gas are being provided for by the erection of new plants at Philadelphia, Harrisburg, Altoona and Columbus, and the capacities of many existing plants are being increased.

A large contract has just been closed by Westinghouse, Church, Kerr & Co., with the Philadelphia Rapid Transit Co. It is for 15,000 k.w. of steam turbine and approximately 50,000 k.w. of electrical generating and converting machinery, for equipping the new Rapid Transit Subway and Elevated Railroad now building in Philadelphia. The steam turbines are to be used for power generation in the new central station. There will be three, each of 5,000 k.w. normal capacity, direct connected to Westinghouse three-phase, 25-cycle generators. The turbines will run at 750 revolutions a minute with 175 lbs. of steam, 27½ in. vacuum and possibly 100 to 150 deg. of superheat. The power station will be located near the foot of Green street, Delaware River. It is laid out for an ultimate capacity of 50,000 k.w. The contract calls for a large amount of transforming and converting machinery, to be installed in several sub-stations. This will be used for converting the high tension alternating current received from the power station into low potential direct current. The first installation will comprise fourteen 1,000-k.w. and two 500-k.w. rotary converters. Each of the 1,000-k.w. rotaries will be furnished with three 375-k.w. stepdown transformers, and each of the 500-k.w. rotaries with three 175-k.w. transformers of similar design.

Interlocking Brake-Shoes.

The economical advantages of the interlocking brake-shoe for cars, described in our issue of Oct. 24, 1902, appear to be receiving general recognition. More than 50 different railroads, private car lines, etc., have ordered these shoes in large and small lots within the last quarter, most of which are reordering in large quantities. The Manufacturers' Railway Supply Co., Chicago, maker of the shoes, in the early part of this month had unfilled orders on hand for over 55,000 car brake-shoes, and about 4,000 of the driver brake-shoe, which was described in our last week's issue.

"Low Moor" Staybolts.

A recent test of "Low Moor" staybolt iron made by one of the leading railroad companies gave the following excellent results. Three specimens were tested and the average figures were: Tensile strength, 51,020 lbs. per sq. in.; elastic limit, 29,656 lbs.; elongation in 8 in., 30.58 per cent. All of the test pieces passed the hot and cold bending tests. The chemical analysis showed: silicon, .074 per cent.; phosphorus, .083 per cent.; iron, 99.43 per cent.; carbon and manganese, traces; sulphur, none. The Low Moor Co., Ltd., New York, are the agents in the United States for this brand of iron.

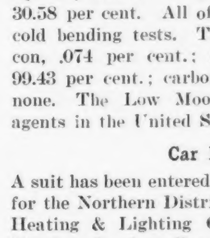
Car Heating Patents.

A suit has been entered in the United States Circuit Court for the Northern District of New York by the Safety Car Heating & Lighting Co. against the Consolidated Car Heating Co. for alleged infringement of its car heating patents. This is the outcome of the claims made by the Safety Car Heating & Lighting Co. to which reference was made in our columns Dec. 5, 1902. The bill was filed by Betts, Betts, Sheffield & Betts of New York City, with Frederic H. Betts, Samuel R. Betts, Edward P. Wetmore and R. Parmly as counsel.

The Gold Car Heating and Lighting Company of New York has brought suit in the United States Circuit Court, at Chicago, against Egbert H. Gold, for infringement of car heating Patent No. 388,722.

Power Hammer.

Messrs. Beaudry & Co., of Boston, make a power hammer of quite simple design which is powerful and durable.



The durability is largely due to an ingenious arrangement for securing elasticity without the use of cushions, straps, or coil springs. The two spring arms of the ram have rolls at their lower ends which operate within the ram upon a concave curved track. The simple, positive, action of the spring arms perfectly controls the ram and causes it to rebound without undue strain the instant the blow is struck. The anvil is an independent casting, not connected with the frame, so as to avoid strain of the hammer parts. It is a neatly designed, efficient tool, occupying small floor space.

Union Engineering Building.

The Joint Committee representing the various bodies which have taken action with respect to the gift of one million dollars of Mr. Andrew Carnegie for a Union Building, was formally organized June 18. The American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the Engineers' Club have taken final action and appointed their representatives upon a Joint Committee for accepting the gift. The American Institute of Mining Engineers has likewise taken action insofar as its rules permit. Its Council has appointed representatives subject to changes in the rules of the organization which have been proposed by the Council for adoption at the next general meeting. A letter ballot is being taken which shows an overwhelming majority of the members in favor of the plans proposed by the Council.

The American Society of Civil Engineers at its recent

meeting in Asheville referred the matter to its Board of Directors for recommendation and directed that a letter ballot be taken.

At the meeting on the 18th inst., the following were announced as representatives of the several bodies upon the Joint Committee:

American Institute of Mechanical Engineers, James M. Dodge, F. R. Hutton, Charles Wallace Hunt.

American Institute of Electrical Engineers, Charles F. Scott, B. J. Arnold, S. S. Wheeler.

American Institute of Mining Engineers, A. R. Ledoux, Charles Kirchoff, Timothy Dwight.

Engineers' Club, John C. Kafer, W. H. Fletcher, W. A. Redding.

Representatives of the American Society of Civil Engineers are requested to meet with the Joint Committee and take part in deliberations with regard to the plans to be adopted. The representatives who have served upon the Conference Committee are Alfred Noble, W. J. Wilgus, George H. Pegram.

The Joint Committee was organized by the election of Charles F. Scott, chairman, and Professor F. R. Hutton, secretary. The Chairman was directed to indicate to Mr. Carnegie the acceptance of his gift by the Joint Committee representing the several organizations.

The Joint Committee placed the immediate work of developing plans upon an Executive Committee of five, consisting of one member from each of the five organizations named in Mr. Carnegie's letter as follows:

Civil Engineers, Mr. Alfred Noble.

Mechanical Engineers, Prof. F. R. Hutton.

Mining Engineers, Mr. A. R. Ledoux.

Electrical Engineers, Mr. Charles F. Scott.

Engineers' Club, Mr. W. H. Fletcher.

The Executive Committee has organized by the election of Charles F. Scott, Chairman, and F. R. Hutton, Secretary. The committee laid out certain work to be undertaken by its several members, and will have meetings from time to time during the summer.

A cablegram has been sent to Mr. Carnegie formally accepting the gift.

Steel Rail Demands for 1904.

The recent announcement that the price of steel rails for the year 1904 will be $28 per ton, and the knowledge that the steel companies will not be able promptly to fill all orders, has made the railroad companies begin early negotiations for steel rails for the ensuing year. The Pennsylvania has ordered 202,000 tons, which is believed to be the largest quantity of steel rails ever ordered by one railroad at one time. This order has been divided as follows: One hundred and eighteen thousand tons to the United States Steel Corporation; 42,000 tons to the Cambria Steel Co., and 42,000 tons to the Pennsylvania Steel Co. No other definite orders have been placed, but it is understood that the Union and the Southern Pacific Railroads will buy about 100,000 tons; the Wabash 75,000 tons, and the Rock Island and St. Louis & San Francisco about 100,000 tons.

THE SCRAP HEAP.

Notes.

The Miller locomotive cab signal is to be tried on the Great Central Railway of England, apparatus for working it having been fitted on the line through Woodhead tunnel. The Board of Trade officers were to inspect the apparatus on June 5.

Beginning July 10, according to an order which has been issued by the State Railroad Commission, the railroads of Arkansas must make reductions of 10 to 15 per cent. in the rates on freight billed through over two or more roads. This is an extension of the Commissioners' "distance tariff," which hitherto has applied only to shipments beginning and ending on the same railroad.

The newspapers report a theft of copper telegraph wire near Trenton, N. J., so large that a reward of $1,000 has been offered for the detection of the thieves. The wire was taken from the lines strung over the Byberry road, between Trenton and Bustleton, Pa. In all 32 wires were cut and a total length of 10 miles is said to have been carried off. The thieves drove through fields.

At St. Louis last week four of the principal railroads filed suits for injunctions against ticket brokers to enjoin them against dealing in excursion tickets for the Saengerfest. Thirty-seven brokers were made defendants. At Harrisburg, Pa., two ticket scalpers have pleaded guilty to unlawful dealing in tickets of the Pennsylvania Railroad, and have been fined $450 and $50 respectively.

Press despatches state that the Baltimore & Ohio will have 60,000 sq. ft. of space in the World's Fair Transportation Building at St. Louis, for an exhibit to be prepared by Major J. G. Pangborn. The exhibit will consist largely of material which was shown at the Chicago exposition, and now in the Field Columbian Museum. It has been arranged to have this exhibit removed to St. Louis. Models of great railroad stations will be shown.

It is announced in the United States Circuit Court of Appeals at Philadelphia that the Western Union Telegraph Company has secured an injunction from the Supreme Court of the United States to restrain the Pennsylvania Railroad from further destroying the telegraph company's poles or wires until the suit, which has been appealed to the Supreme Court, has been decided. Press despatches do not say which suit this statement refers to or whether it refers to more than one. The Western Union gives a bond to the defendants for $100,000. The order is dated at Altamont, N. Y., and is signed by Justice Peckham.

The Legislature of Florida has passed a law, to go into effect at the beginning of next year, requiring railroads to equip all of their platform cars with "supports, stays, strips, railing and other equipments and appliances necessary to hold and keep a cargo of lumber firmly in place"; and in case of failure, making it necessary for the shipper to furnish the stakes himself, the railroad is to pay a penalty of $1.50. For this penalty the shipper shall have a lien on the car. The lumbermen, who secured the passage of this law, say that the stakes and other fastenings for a carload of lumber usually cost about $3; and they complain, not only of the cost, but also that the railroads make them pay for the transportation of these fittings, which weigh from 800 to 1,100 lbs. per car.

Gold Car Heating and Lighting Company.

The amount of Gold heating apparatus sold during the past year was nearly double that of any former year since the origin of this business. The increase has been in its steam car heating department, as well as in the electric heating. Orders recently taken are as follows:

	Equipments.
Canadian Pacific	290
Brooklyn Heights R. R.	240
Missouri Pacific	125
Wabash	105
Erie	102
New York, New Haven & Hartford	101
Massachusetts Electric Companies	100
Metropolitan Street Railway	100
Southern	79
Louisville Railway	75
Central R. R. Co. of N. J.	58
New York Central & Hudson River R. R.	45
New Orleans & North Eastern	40
Boston & Albany	37
C., C., C. & St. L.	36
Denver & Rio Grande	35
Chicago & Eastern Illinois	32
Western Maryland	21
South Side Elevated	20
Scranton Railway	15
Nashville, Chattanooga & St. Louis	21
M., St. P. & S. S. M.	22
Cincinnati, Hamilton & Dayton	12
Texas & Pacific	24
Georgia R. R.	4
Lake Shore & Michigan Southern	15
Boston & Maine	28
New York, Ontario & Western	14
Delaware, Lackawanna & Western	25
Chesapeake & Ohio	5
Atlanta & West Point	6
Central of Georgia	14
Alabama Great Southern	4
Cincinnati, New Orleans & Texas Pacific	14
Vicksburg, Shreveport & Pacific	8
Alabama & Vicksburg	6
Mobile & Ohio	15
Louisville & Nashville	3

PERSONAL.

—Mr. William Lyman Squire, who for nearly 25 years has been Treasurer of the New York, New Haven & Hartford, died at his home in Meriden, Conn., June 19, at the age of 72 years. Mr. Squire had been connected with the New Haven road for about 50 years, having started as paymaster for the Hartford & New Haven.

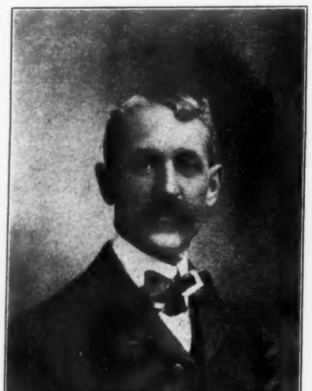
—Mr. J. E. Gillmor, Signal Engineer of the Long Island Railroad, has resigned, the resignation to take effect at the end of this month. Mr. Gillmor intends to establish an office in Pittsburg as consulting signal engineer. He has been on the Long Island road about a year and had had a long experience on the Pennsylvania before going to the Long Island.

—Mr. Elmer H. Morse, the new Assistant Superintendent of the Providence and Midland Divisions of the New York, New Haven and Hartford, which two divisions are now combined under Mr. C. N. Woodward, is promoted from the position of Chief Despatcher. He was born at Lowell, Mass., in 1862. At the age of 18 he entered the freight office of the Old Colony at Fitchburg. He was later taken into the Superintendent's office, of what was then the Northern Division, as an operator. In 1887 he was made chief despatcher, and when the Old Colony leased the Boston & Providence, Mr. Morse was transferred to Boston as chief despatcher of the Providence and Northern Divisions of the Old Colony, and continued in that position after the consolidation of the latter road with the New Haven.

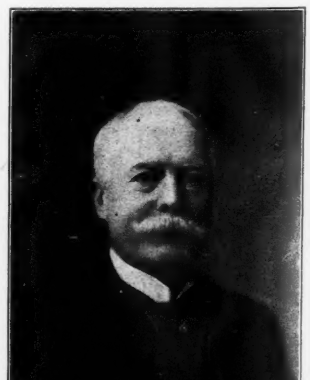
—Mr. George L. Sands, Vice-President and General Manager of the St. Louis & North Arkansas, began his railroad service with the Chicago & North Western as a brakeman. He was for a time with the Union Pacific as Train Despatcher, and for two years (1870-1872) he was Division Superintendent of the Missouri, Kansas & Texas. In 1875 he was engaged in railroad construction in Brazil and Argentine Republic, and afterwards was a trainmaster for the Atchison, Topeka & Santa Fe. He was later made Division Superintendent of this company, and for three years (1887-1890) was its General Superintendent. For a time he held a similar position with the San Antonio & Aransas Pass, finally becoming Manager. In 1892 he was appointed Second Vice-President and Manager for the Wiggins Ferry Company, and in 1902 was appointed Vice-President of the St. Louis & North Arkansas.

—Mr. William Henry Rosevear, who last week was elected President of the International Association of Car Accountants and Car Service Officers, at the annual meeting of the Association at Quebec, is the General Car Accountant of the Grand Trunk Railway of Canada, and is one of the pioneer members of the Association. Mr. Rosevear was born at Wadebridge, Cornwall County, England, in 1837, and received his early education in the schools of Bodwin, England. In 1854 he went to Canada and his first railroad service was in the car shops. This was on the Great Western at Hamilton. He did mechanical work, however, but a few years and was soon made a clerk in the mechanical department. In 1862 he left the Great Western and went to the Grand Trunk, these two being at that time separate companies. On the Grand Trunk he was Mechanical Accountant at Montreal. He took charge of the car accounting office in 1890, and he has held his present title since 1896. Mr. Rosevear has been the author of some of the most instructive and valuable papers that have been read before the Car Accountants' Association, and he is one of the most popular members of the organization.

—Mr. Charles S. Rhoads, the recently elected President of the Railway Telegraph Superintendents' Association, is the Superintendent of Telegraph of the Cleveland, Cincinnati, Chicago & St. Louis. He was born near Cincinnati, Ohio, and is now 49 years old. He began his railroad service as a telegraph operator when he was 19, and was made a train despatcher in 1880. Practically all of his railroad service has been on what is now the Big Four. In 1889 he was made Trainmaster of the Cincinnati Division, and two years later was appointed Superintendent of Telegraph. Mr. Rhoads is a man of strong character and pleasing personality. He has always been one of the leaders in the Association, at the head of which he is now placed. He is also an active member of the Railway Signaling Club, the duties of his office having for several years included supervision over much of the signaling on his road.



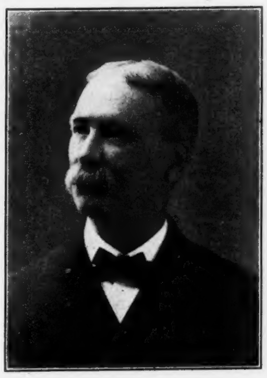
—Mr. Henry C. Hope, the President of the Railway Signaling Club, is the Superintendent of Telegraph and Signals of the Chicago, St. Paul, Minneapolis & Omaha. Mr. Hope was born in Rockford, Ill., and is about 53 years old. His first railroad service was on the Chicago, Milwaukee & St. Paul, where he began in 1873, and where he served as operator and despatcher. He has held his present position, however, for 23 years, and is thus one of the pioneers of the service. In 1900 he was President of the Old Time Telegraphers' Association. With the excellent portrait here shown it is unnecessary to tell the reader that Mr. Hope has a pleasing personality. He is one of the most popular members of the Railway Signaling Club and also of the Railway Telegraph Superintendents' Association. On the "Omaha" he has charge not only of the telegraph and signal departments, but of electrical matters generally, including power plants and lighting.



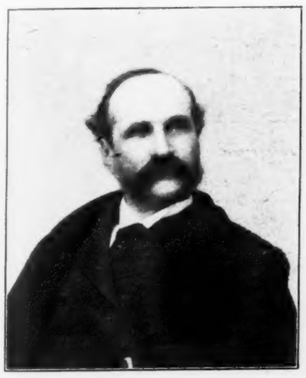
—Mr. T. C. Moorshead, who has just been appointed Chief Engineer of the Illinois Terminal at Alton, Ill.,

started as a rodman for the St. Louis, Peoria & Northern, and remained with that company during its construction. Upon its completion he was made draughtsman in the Chief Engineer's office. During this time (1895-1899) Mr. Moorshead studied civil engineering, and in the fall of 1899 he was made Assistant Engineer of the Terminal Railroad Association of St. Louis, where he has remained up to the time of his appointment on the Illinois Terminal.

—Mr. A. W. Martin, the new Assistant General Superintendent of the New York, New Haven & Hartford, has been in railroad service ever since early boyhood. He began in 1867 as a freight clerk at Southbridge for the old Boston, Hartford & Erie. He worked at various places on the road until 1880, when upon the death of his father he was appointed to succeed him as station agent at Southbridge. In 1891 he became General Agent of the New England road, and two years later was made chief clerk to the General Superintendent of the Old Colony and remained in that position after the consolidation of the Old Colony and the New Haven, and until 1898, when he was made Secretary to General Manager Chamberlain. Mr. Martin resigned from this latter position last month to become General Manager of the Worcester & Connecticut Eastern, an electric road controlled by the New Haven, from which position he now resigns to go back to the New Haven road as Assistant General Superintendent, with office at Boston.



—Mr. Alphonse Fteley, a prominent civil engineer, and who in 1898 was President of the American Society of Civil Engineers, died on June 13, at his home in Yonkers, N. Y. Mr. Fteley was born in France in 1837 and graduated from the Polytechnic School of Paris. In 1873 he was appointed Resident Engineer of the additional water supply of the city of Boston, and up to the time of his death was Consulting Engineer of the Metropolitan Water and Sewerage Board of that city. Mr. Fteley was connected with the New York Aqueduct Commission for about 16 years as executive and chief engineer. He resigned Dec. 31, 1899, on account of ill health. Mr. Fteley was a notable representative of the highest class of the professional Civil Engineer. Beginning with a thorough scientific education, he acquired practical experience in the designing and construction of hydraulic works. Ever a thorough student and careful observer of the progress of science and its practical applications he sought diligently and intelligently for the causes of failures and the means of improvements in design and construction of works in which he was engaged, and he was always ready to impart to the whole profession the conclusions which he reached and the steps by which they had been arrived at. In the consideration of the questions involved in the betterment of the water supply of Boston and later that of New York city, his extensive and thorough investigations and experiments on the yield of water sheds, the flow of water in open and closed channels, and the design of conduits, reservoirs and dams, set the standard for that class of work in the United States and established his position as an investigator and an adviser, in matters both of theory and practice. He held the affection of his subordinates and the esteem and lasting confidence of his employers. This was due largely to his attractive personality, his impartiality in considering all sides of problems which came before him, and the facility he possessed of elucidating complicated questions in a manner which impressed the conviction of his entire grasp of the subject and his thorough integrity.



ELECTIONS AND APPOINTMENTS.

Atchison, Topeka & Santa Fe.—L. K. Sherman, of the Bridge Department, has resigned.

Atchison, Topeka & Santa Fe Coast Lines.—S. L. Bean has been appointed Master Mechanic, with headquarters at Albuquerque, N. Mex., succeeding F. P. Barnes. A. S. Jennings has been appointed Auditor, with office at Los Angeles, Cal., succeeding J. W. White.

Baltimore & Ohio.—J. B. Cameron has been appointed Division Engineer at New Castle, Pa., succeeding J. G. Bloom, resigned. (See Chicago, Rock Island & Pacific.)

Canadian Pacific.—E. J. Chudleigh has been appointed Superintendent of the Western Division, with headquarters at Moose Jaw, N. W. T., succeeding D. R. Bell, who has been transferred to Toronto.

Chicago, Rock Island & Pacific.—J. G. Bloom, heretofore Division Engineer on the Baltimore & Ohio, has been appointed Principal Assistant Engineer of the C., R. I. & P., with headquarters at Topeka, Kan.

Delaware & Hudson.—A. I. Culver, Third Vice-President, has been appointed General Manager, also, succeeding H. G. Young, who resigns on the first of July.

Grand Trunk.—X. H. Cornell, heretofore Trainmaster, has been appointed Master of Transportation, with office at Durand, Mich., succeeding A. H. Lander, resigned.

Gulf, Beaumont & Kansas City.—C. J. Webb has been appointed Auditor, with office at Beaumont, Texas, succeeding J. E. Baxter. (See Gulf, Colorado & Santa Fe.)

Gulf, Colorado & Santa Fe.—J. E. Baxter has been appointed Auditor, with office at Galveston, Texas, succeeding A. S. Jennings, who has been transferred to the Atchison Coast Lines.

Lehigh Valley.—L. H. Van Allen, Superintendent of the Buffalo Division, with headquarters at Buffalo, N. Y., has resigned, to take effect July 1.

Licking River.—E. R. Miller, heretofore Superintendent, has been appointed General Manager, with headquarters at Yale, Ky., succeeding E. W. Strack, resigned.

Long Island.—A. L. Langdon has been appointed General Freight Agent, with office at New York city, succeeding W. H. Drayton, Jr., resigned.

New York, New Haven & Hartford.—It is reported that N. H. Heft, Chief of the Electrical Department, with headquarters at New Haven, Conn., is to retire.

Pere Marquette.—C. M. Hunt, formerly Trainmaster, has been appointed Superintendent of the Grand Rapids District, succeeding E. E. Hughes, who has resigned to go into banking business.

Southern.—W. B. Darrow has been appointed Assistant to the Superintendent of Transportation at Washington, D. C.

Southern Pacific.—T. J. Anderson has been appointed General Passenger Agent, and Joseph Hellen Assistant.

Susquehanna & New York.—Charles H. Hammond, heretofore General Freight and Passenger Agent of the Pittsburgh, Shawmut & Northern, has been appointed Traffic Manager of the S. & N. Y., with headquarters at Williamsport, Pa. At a meeting held recently the following officers were appointed: R. G. Brownell, Secretary; F. E. Bradley, Treasurer; C. S. Du Bell, Assistant Treasurer; George C. Darling, Auditor; J. M. Rhen, Chief Accountant, and C. H. McCauley, General Solicitor.

Texas & Pacific.—Frank Tremble, heretofore Assistant Superintendent of Telegraph, has been appointed Superintendent of Telegraph.

Toledo & Western (Electric).—J. S. Clark, Purchasing Agent, with office at Sylvania, Ohio, has resigned.

Weatherford, Mineral Wells & Northwestern.—The officers of this company are: G. J. Gould, President; L. S. Thorne, First Vice-President; P. E. Bock, Second Vice-President, General Superintendent and General Freight and Passenger Agent; J. W. Boot, Secretary, Treasurer and Auditor, and T. J. Freeman, General Attorney.

LOCOMOTIVE BUILDING.

The Southern Indiana is having 10 locomotives built at the Baldwin Works.

The Vera Cruz & Pacific is having five locomotives built at the Baldwin Works.

The Southern Ry. is having 32 locomotives built at the Richmond Works of the American Locomotive Co.

The Canadian Pacific has ordered twenty 10-wheel compound freight locomotives from the North British Locomotive Co. (formerly Neilson, Reid & Co.), Glasgow, Scotland, for October and November, 1903, delivery. These locomotives will be exact duplicates of those now building for this road by the Saxon Engine Works, Chemnitz, Germany, dimensions of which were given in our issue of March 13 last.

The Elgin, Joliet & Eastern, as reported in our issue of June 12, has ordered four simple six-wheel switching (0-6-0) locomotives from the Baldwin Works, for February, 1904, delivery. These locomotives will weigh 130,000 lbs.; cylinders, 19 in. x 26 in.; straight boiler, with a working steam pressure of 180 lbs.; 270 National tubes 2 in. in diameter and 10 ft. 6 in. long; Illinois Steel Company's steel fire-box, 96 in. long and 33½ in. wide; tank capacity, 4,000 gal.; coal capacity, eight tons. Special equipment includes Westinghouse air-brakes, Baldwin Locomotive Co.'s axles and springs, Keasbey & Mattison magnesia boiler lagging, Buckeye couplers, Adams & Westlake headlights, one Simplex and one Ohio injector, National Fulton Brass Mfg. Company's journal bearings, U. S. piston rod and valve rod packings, Coale safety valves, Leach sanding devices, Nathan sight feed lubricators, and Crosby steam gages.

The Minneapolis, St. Paul & Sault Ste. Marie, as reported in our issue of June 12, is having seven consolidation (2-8-0) and seven mogul (2-6-0) locomotives built at the Schenectady Works of the American Locomotive Co., for September and October, 1903, delivery respectively. The 2-8-0 locomotives will weigh 180,000 lbs., with 157,600 lbs. on drivers; cylinders, 22½ in. x 35 in.; straight top radial stay boiler, with a working steam pressure of 210 lbs.; heating surface, 2,633 sq. ft.; 326 charcoal iron tubes, 2 in. in diameter and 14 ft. 6 in. long; Otis steel fire-box 102 in. long and 65 in. wide; grate area, 46 sq. ft.; tank capacity, 6,000 gal., and coal capacity, 10 tons. The 2-6-0 locomotives will weigh 148,000 lbs., with 125,000 lbs. on drivers; cylinders, 21 in. x 32½ in.; extended wagon top radial stay boiler, with a working steam pressure of 200 lbs.; heating surface, 1,847.6 sq. ft; 268 charcoal iron tubes 2 in. in diameter and 12 ft. 4 in. long; Otis steel fire-box 90 in. long and 62 in. wide; grate area, 38.96 sq. ft.; tank capacity, 6,000 gal.; coal capacity, 10 tons. Special equipment for both includes Westinghouse air-brakes, Taylor iron axles, Gollmar bell ringers, Keasbey & Mattison magnesia boiler lagging, Washburn couplers, Ohio injectors, Ajax metal journal bearings, Paxton-Mitchell piston rod and valve rod packings, Crosby safety valves and steam gages, Leach sanding devices, Chicago sight feed lubricators, Railway Steel Spring Co.'s springs, Midvale tires on driving and truck wheels, cast-steel wheel centers, and Common Sense tender truck bolsters.

CAR BUILDING.

The Pullman Co. is building three coaches for general service.

The American Car & Foundry Co. has miscellaneous orders for 38 cars.

Wonham & Magor have ordered 20 box cars from the American Car & Foundry Co.

The Erie has ordered one standard double ballast plow from the American Car & Foundry Co.

The Virginia & Southwestern is having 100 freights built at the Southern Car & Foundry Co.

The Richmond, Fredericksburg & Potomac is in the market for four combination baggage and mail cars.

The San Diego, Cuyamaca & Eastern is having 10 freights built at the Pease Car & Locomotive Works.

The Bangor & Aroostook is having 20 freights built at the Berwick Works of the American Car & Foundry Co.

F. M. Hicks, of the Hicks Locomotive & Car Works, has received an order to build one private car for the use of the Missouri Fish Commission.

The United Railroads of San Francisco have ordered 50 street cars from the St. Louis Car Co. These cars are to be 39 ft. 6 in. long, open at both ends, with a seating capacity of 44 people.

The International & Great Northern, as reported in our issue of June 19, contemplates building 100 I. & G. N. standard stock cars of 80,000 lbs. capacity at its Palestine shops. The cars will be 36 ft. 6¾ in. long, 9 ft. 4 in. wide and 7 ft. 3 in. high. The special equipment includes: Westinghouse air-brakes, Tower couplers, Harrison dust guards and I. & G. N. door fastenings and standard steel trucks.

BRIDGE BUILDING.

ALLENTOWN, PA.—It is reported that a bridge will shortly be built across the Lehigh River at Hamilton street. The new bridge will be made of steel, with five spans, each 135 ft. long. The old bridge at this point was washed away by the flood in February of 1902.

ANDERSON, IND.—Bids will be received until July 7 for building the masonry substructure of a bridge 685 ft. long over the White River at Delaware street. Otis P. Crim, County Auditor.

CATLETTSBURG, KY.—Bids will be received until June 30 for three steel bridges, 308 ft., 70 ft. and 54 ft. long respectively, across Buckeyes, Tollets and Stone creeks. John McDyer is the engineer in charge of the work.

CUMBERLAND, MD.—The Western Maryland R. R. has filed application for permission to build seven bridges across the Chesapeake & Ohio canal between Big Pool and Cumberland. No contracts have been let. V. G. Bogue, 15 William street, New York, is Consulting Engineer, and J. Q. Barlow, Cumberland, Md., Chief Engineer.

It is reported that plans have been approved for the erection of a bridge across the Potomac River, between Cumberland and Sinclairsville, W. Va. The bridge will cost approximately $10,000.

DES MOINES, IOWA.—It is reported that a new girder bridge costing approximately $75,000 will be built across the Des Moines River by the Chicago, Rock Island & Pacific R. R.

HOT SPRINGS, ARK.—It is reported that bids are now being received by the County Judge for a bridge 450 ft. long across Ouachita River.

KANSAS CITY, MO.—The steel bridge of the Chicago, Rock Island & Pacific, which was washed away in the recent floods at Kansas City, will be replaced by a new bridge, which will be an exact duplicate of the old one.

NEWARK, N. J.—Bids are being asked for rebuilding the draw of a bridge over the Passaic River. Proposals will be received at 196 Market street, Newark, until 4 p.m., June 30.

NEW YORK, N. Y.—Bridge Commissioner Lindenthal has submitted a plan for the approach to the Blackwell's Island bridge. The plan is now before the Board of Estimate.

ST. MARY'S, KAN.—The County Commissioners are reported to have made plans for building a bridge across the new branch which has recently been formed by the Kansas River at this point. The river is now flowing through the old as well as the new channel. It is also reported that the bridge across the original channel which was washed away will be rebuilt.

SPARTANBURG, S. C.—The 350-ft. steel bridge across the Pacolet River, near Spartanburg, was washed away by the recent floods; also the 142-ft. three-span bridge across Middle Tiger River.

STRATFORD, ONT.—Bids will be received until July 4 for the superstructure of a steel bridge over Nith River, in the Township of North Easthope. The bridge will have a span of 120 ft. Plans may be seen at the office of the Chief Engineer, Angus Smith, Stratford, Ont.

STROUDSBURG, PA.—It is reported that an iron or steel bridge will be built across the Delaware near Stroudsburg.

Other Structures.

AMARILLO, TEXAS.—Arrangements are reported completed for building machine shops for the Choctaw R. R., to cost approximately $80,000.

AUSTIN, TEXAS.—It is reported that the Missouri, Kansas & Texas has recently purchased a large amount of ground for station facilities in the eastern part of the city.

BIRMINGHAM, ALA.—The Seaboard Air Line is about to rebuild the roundhouse and shops which were recently damaged by fire.

CLEVELAND, OHIO.—The Suburban Depot Co. is asking bids for building a new station. The plans call for a building 160 ft. long and 40 ft. wide.

LANCASTER, PA.—The Philadelphia & Reading is asking bids for a new station to replace the present one at Prince street.

LOS ANGELES, CAL.—The Southern Pacific is planning to replace the Arcade station with a large and complete new structure. Details have not yet been given out.

NAVASOTA, TEXAS.—Plans for a new passenger station of the Houston & Texas Central in this city have been finished. It is estimated that the new structure will cost approximately $15,000.

OAKLAND, CAL.—The Southern Pacific will build a new passenger station at First street, between Broadway and Franklin street.

PHILADELPHIA, PA.—The Philadelphia Rapid Transit Co. is preparing to build a $1,500,000 power house near the Delaware River, between Green and Beech streets.

PORTSMOUTH, OHIO.—The Norfolk & Western has approved plans for a passenger station and a freight house.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ALASKA CENTRAL.—A contract has been awarded to a Chicago company for building 413 miles of this road from Resurrection Bay north through the Cook Inlet country, up the Sustina valley to the Tanana River. The company has ordered a large quantity of 70-lb. steel rails, and these have already been shipped from Vancouver. It is reported that work will be begun in July. George W. Dickinson, of Tacoma, Wash., formerly an officer of the Northern Pacific, is President of the new company. (June 5, p. 399.)

BALTIMORE & OHIO.—It is reported that the McArthur Bros. Co. will sub-let several sections of its contract on the new line between Ravenna and Cuyahoga, Ohio. W. G. Sloan, Ravenna, is the superintendent in charge of the work.

BEAUMONT, SOUR LAKE & HOUSTON (ELECTRIC).—Contract for building this electric line from Beaumont to Sour Lake has been awarded to J. W. Gavis, Houston, Texas. Work will be begun at once, and it is expected that the grading will be completed before the end of the summer. (See Construction Supplement.)

BELLINGHAM BAY & BRITISH COLUMBIA.—Contract for the extension of this line from Hampton Siding, Wash., west to Lynden, five miles, has been let to A. C. Goerig, of Everett, Wash. Work will be begun immediately. (June 12, p. 415.)

BUFFALO, DUNKIRK & WESTERN.—An officer writes that this line which is now building between Fredonia, N. Y., and Westfield, is under contract to J. E. Latimer, 203 Ellicott Square, Buffalo, N. Y. The new line will connect with the Lake Erie Traction at Westfield. (June 19, p. 449.)

BUFFALO, ROCHESTER & PITTSBURGH.—An officer writes that contract for grading a branch line of this company from Creekside, Pa., to Whiskey Run, 17 miles, has been let to F. H. Clement & Co., Philadelphia. (June 5, p. 400.)

CAPE GIRARDEAU TERMINAL.—Incorporation has been granted this company in Missouri, to build a railroad from a connection with the St. Louis, Memphis & Southeastern near Cape La Cruche Creek to Cape Girardeau. F. E. Dewey and J. H. Force, of Cape Girardeau, Mo., are interested.

CHATHAM, WALLACEBURG & LAKE ERIE.—A charter has been granted this company by Parliament, with power to build from Rondeau, Ont., to Wallaceburg, via Chatham, with branches to Petrolia and to Blenheim. William E. McKeough, Chatham; H. L. Dunn, Toronto; D. A. Gordon, Wallaceburg, and others are incorporators.

CHICAGO, MICHIGAN & INDIANA ELECTRIC.—This company has been incorporated in Michigan, with a capital stock of $3,000,000, for the purpose of building an electric line from Chicago through northern Indiana, and to the cities of Dowagiac, St. Joseph, Benton Harbor and Paw Paw, in Michigan, with branches to Kalamazoo and Allegan. Chas. G. Davies, Benton Harbor, Mich., is the principal stockholder.

CINCINNATI, HAMILTON & DAYTON.—Contract is reported let for the extension of this line from Delphos, Ohio, north to Mandale, 12 miles. The new line, when completed, will parallel the Toledo, St. Louis & Western for the greater part of the distance.

DETROIT & TOLEDO SHORE LINE (ELECTRIC).—This line, which was recently acquired by the Grand Trunk, is practically completed from Trenton to Delray, Mich., 10 miles. It is stated that trains will begin running about July 1.

GEORGIA ROADS.—The Flowers Lumber Co. is reported to be building a logging road 10 miles long from Jakin, Ga., into timber lands.

GRAND VALLEY, COLORADO RIVER & SOUTHERN PACIFIC.—Incorporation has been granted this company in Utah. The proposed route is from Grand Junction, down the Grand Valley to the Colorado River, and thence to the Pacific coast. Names of promoters are not given.

GREAT NORTHERN OF CANADA.—Press reports state that a contract has been awarded to P. Welch, Spokane, Wash., for grading the extension of this line from Columbia, B. C., to the Granby, British Columbia and Montreal mines near Greenwood. (See Construction Supplement.)

GUELPH & GEORGIAN BAY.—A charter has been granted this company, with power to build from Guelph, Ont., north through Elora, Arthur and Mount Forest to Owen Sound, 75 miles, with branches to Meaford and Orangeville. D. Guthrie, Guelph, Ont., is said to be interested. (See Construction Supplement.)

HAMILTON, BERLIN & COLLINGWOOD.—A charter was granted this company at the recent session of the Dominion Parliament. The proposed route is from Hamilton, Ont., north via Galt and Berlin to Collingwood, 90 miles. Clarke, Gowan, Bartlett & Bartlett, Windsor, Ont., are interested. (March 20, p. 220.)

HAYNEVILLE.—An officer writes that the proposed route of this road is from Hayneville, Ala., east to Morganville, 10 miles, connecting at the latter point with the Louisville & Nashville. The line has been surveyed and an engineer estimates that the cost of building will be very low. No officers have as yet been elected, as under the laws of the State one month must elapse from the time of the granting of the charter before an election can take place. H. S. Houghton, Hayneville, and others are incorporators. (June 12, p. 416.)

ILLINOIS CENTRAL.—Press reports state that contracts will be let within the next 30 days for a cut-off between Etters, Tenn., and Lakeview, Miss., 6½ miles. The present line between these two points makes a circuit around several large hills. The proposed cut-off will be about two miles shorter than the present route. It is estimated that the proposed work will cost about $200,000.

INDIANAPOLIS SOUTHERN.—Contracts will shortly be let for building this new line from Indianapolis, via Morgantown, Bloomington and Bloomfield to Sullivan, 140 miles. Surveys are reported completed and rights of way secured. D. M. Parry is President, and T. H. Hazelrigg, Indianapolis, Ind., Chief Engineer. (See Construction Supplement.)

IOWA & ILLINOIS.—This company has filed an amendment to its articles of incorporation with the Secretary of State of Iowa, increasing the capital stock from $125,000 to $1,500,000. The company has secured the right of way for its line from Davenport, Iowa, to Clinton, and will commence work within a few weeks. It is the intention of the officials to complete the line between the two points by the end of 1903. G. D. McDaid, Clinton, is President, and F. W. Ellis, Secretary.

KANSAS, GALATIA & SMOKY VALLEY.—This company has been incorporated in Kansas to build a line from Lorraine, through Ellsworth, Rush, Barton and Ellis Counties, to Ellis, 75 miles. James Armstrong, Galatia; W. M. Whitelaw, Kansas City; F. W. Casnew, Hutchinson, and others are incorporators.

LAKE KEUKA & EAST SIDE ELECTRIC.—Bids are now being asked by this company for grading its line from Penn Yan, N. Y., to Keuka, 34 miles. M. F. Sheppard, Penn Yan, or Burke & Sheppard, 44 Pine street, New York City, may be addressed. (June 19, p. 449.)

LOUISVILLE & NEW ALBANY TRACTION.—This company has been incorporated in Indiana, to build an electric railroad from New Albany to Louisville, Ky. J. W. Dunbar, New Albany; J. F. Stratton, Jeffersonville, and others are directors.

LOUISVILLE & SOUTHERN INDIANA TRACTION.—Articles of incorporation have been filed by this company in Indiana. It is proposed to build an electric line from New Albany to Jeffersonville, passing through Floyd, Clark, Harrison, Orange and other counties. The company is capitalized at $3,000,000.

MCKEESPORT & CLAIRTON CONNECTING.—A charter has been granted this company in Pennsylvania, to build a steam railroad four miles long from a point at the intersection of Market street and First avenue, in the city of McKeesport, to a point near Clairton, in Allegheny County, Pa. J. D. O'Neil, McKeesport, is President.

MADERA R. R.—This company has been incorporated in California to build a line from Curtis Station, on the Southern Pacific, to large granite quarries in Madera County. J. C. Campbell, R. W. Campbell and A. G. Towne, Madera, Cal., are said to be interested.

MEXICAN ROADS.—The Government of the State of Tamaulipas, Mexico, has approved the contract between Governor Pedro Aguelles and A. J. Gonzales for building and operating a new railroad from Xicotencatl, in the State of Tamaulpas, to a point on the Gulf Division of the Mexican Central.

MICHOACAN & PACIFIC.—It is reported that this road, which runs from Maravatio, Mexico, to Zitacuaro, 56 miles, is to be changed from narrow to standard gage. The road is owned by the Trojos Mineral Co., but is operated by the National R. R. of Mexico.

MISSOURI, KANSAS & TEXAS.—Press reports state that location surveys are now being made for a branch line from Georgetown, Texas, to Austin, 50 miles. It is reported that work will be begun as soon as surveys are finished.

MOBILE, JACKSON & KANSAS CITY.—Rights of way are reported secured by this company for the proposed extensions in Mississippi. The Worthington Construction Co. is reported to have begun work on an extension 11 miles east from Newton, Miss.

MORELIA & TACAMBARO.—The Mexican Government has modified its original concession to this road. Under the new contract the company agrees to build 30 kilometers (18½ miles) on or before May 1, 1904, and 30 kilometers additional each year following. The company also agrees to complete its line from Piadad to Tacambaro, 150 miles, by May 24, 1909. (May 8, p. 336.)

NATIONAL R. R. OF MEXICO.—Surveys are reported finished on the extension of this line from Marfil, Mexico, to Guanajuato, six miles. Grading will be begun very shortly. R. T. McDonald, Mexico City, is the engineer in charge of the work.

NEW MEXICO NORTHERN.—Press reports state that work will shortly be begun on this line from Bland, N. Mex., to Thornton, 20 miles. Connection will be made with the Atchison, Topeka & Santa Fe at Thornton. D. C. Dunlap, Albuquerque, N. Mex., is Chief Engineer. (See Construction Supplement.)

NORTHERN PACIFIC.—Contract has been awarded to Guthrie & Co., St. Paul, Minn., for changing the grade and tracks of the main line of the Northern Pacific from Thornton, Idaho, to Kootenai, 16 miles.

PENNSYLVANIA.—Contracts have been awarded to the Smith Construction Co. for the change of line between Mayes and Granville, on the Middle Division. The work will include the excavation of about 250,000 cu. yds. of earth. The same firm has also received a contract for the change of line from Manayunk bridge to Kelley's culvert, and from the west end of Kelley's culvert to Newton Hamilton.

PENNSYLVANIA ROADS (ELECTRIC).—Press reports state that a company is to be formed in Philadelphia to build an electric line from Sharon, via Greenville and Mercer, to Franklin, 40 miles. Frederick Snyder, Philadelphia, is said to be interested.

PRESCOTT & UNION.—This company has been incorporated in Arizona, to build from Whipple Barracks via Prescott, to Palace, 25 miles. F. L. Wright and T. C. Job, Prescott, Ariz., are incorporators.

RIO GRANDE, SIERRA MADRE & PACIFIC.—It is reported that this company will build an extension of its line southwest from Terrazas to Minaca, 110 miles, where a connection will be made with the Chihuahua & Pacific.

RIO SECO.—The original concession granted to this company by the Mexican Government has been modified so as to permit the building of a line from Cardenas, on the Mescalapa River, to Paraiso. According to the terms of the new contract, 10 kilometers (6.2 miles) must be finished before November, 1903, and 10 additional kilometers must be completed every year until the entire road is completed. Benj. Barrios, Mexico City, is said to be interested. (See Construction Supplement.)

ST. LOUIS & SAN FRANCISCO.—The *Manufacturers' Record* states that the contract has been awarded by this company to the Carnegie Steel Co. for 42,000 tons of rails, to be laid on the proposed extension from Deckerville, Ark., south to New Orleans, La., 380 miles.

SALEM TERMINAL TRACTION.—A charter has been granted to this company in West Virginia to build an electric line from Clarksburg to Salem, 15 miles. Surveys are reported in progress and contracts for grading will shortly be let. J. E. Law, Clarksburg, W. Va., is said to be interested.

SAN FRANCISCO.—A contract has been let for grading an additional 10 miles of this line north of Willits, Cal. Twenty miles of line were graded in 1902, and the line will now be extended to Eureka, 150 miles. (May 29, p. 384.)

SONORA, CHIHUAHUA & MONTEREY.—This company is about to be organized, with a capital of $20,000,000. The promoters include L. M. Goddard, James B. Orman and F. P. Bertochy, of Denver, Colo. The Mexican Government has given the company valuable concessions. The proposed route has not yet been decided upon.

SOUTHERN.—An officer writes that no decision has yet been reached with regard to changing the present main line of the road between Amherst and Charlottesville, Va. Several preliminary lines are now being surveyed between these points to ascertain whether it would be better to build an independent line for through freight and through passenger trains, rather than to double track and reduce the grades on the present line.

SOUTHERN INDIANA.—Surveys are reported finished for the extension of this line from Elnora, Ind., to Evansville, 80 miles. (See Construction Supplement.)

TOLEDO & ANN ARBOR ELECTRIC.—Press reports state that this company has let a contract for grading its proposed line from Toledo to Ann Arbor, 55 miles. Rights of way have been secured and it is stated that work will be begun immediately. J. N. Griffith, Wyandotte, Mich.; M. C. Briggs, Fostoria, Ohio, and others are interested. (June 12, p. 416.)

VERNON, ROSWELL & EL PASO.—Surveys are reported finished for this line from Vernon, Tex., west to Alamagordo, N. Mex., about 300 miles. It is reported that grading will shortly be begun. Connection will be made with the Blackwell, Enid & Southwestern at Vernon, and with the El Paso Southwestern at Alamagordo. (April 17, p. 209.)

WASHINGTON & PACIFIC.—An officer writes that the proposed route of this road is from Orondo, Douglass County, Wash., via Waterville to Buckingham, 70 miles. Surveys are now in progress and contracts for grading will be let about July 15. There will be no important bridges. H. L. Phillips, Seattle, Wash., is Chief Engineer. (June 5, p. 400.)

WESTERN ELECTRIC.—Articles of incorporation have been filed by this company in Indiana to build an electric line from Logansport to Fowler. The estimated length of line is 150 miles. H. B. Smith, Hartford City; W. M. Elliott, Logansport; E. B. Sellers, Monticello, and others are incorporators.

GENERAL RAILROAD NEWS.

CUBA EASTERN.—This company is offering at par and interest $600,000 of its authorized issue of $1,000,000 first mortgage 6 per cent. 30-year $1,000 gold bonds. The circular says in part: This company is organized for the purpose of building a standard gage steam railroad, 43 miles long, from Granadillo Bay northwest through Guantanamo, and thence through a large tract of valuable timber land belonging to the Cuba Hardware Co. Granadillo Bay is considered one of the finest harbors in Cuba, and has been selected by the United States as its main coaling and naval station in the Island of Cuba. It is proposed to eventually extend the line in a northwesterly direction to Nipe Bay, with a branch east to Baracoa. H. W. Bennett, 79 Wall street, New York, is President of the company.

METROPOLITAN STREET RAILWAY (NEW YORK).—The suit brought by Isidor Wormser, Jr., to break the lease of the Metropolitan to the Interurban Street Ry. Co., which has been on trial before the New York Supreme Court for nearly two weeks, has been dismissed. The suit was based on two points; first, that the whole agreement between the two companies was fraudulent, and, secondly, that the syndicate who undertook to carry the agreement out, did so, not in the interest of the stockholders, but for their own advantage and profit.

NEW YORK & PORTCHESTER.—The New York State Court of Appeals has sustained the permission recently granted by the State Railroad Commission for building this line from Portchester to New York. The plan calls for a four-track electric railroad from the Harlem River, northeastward eight miles through the city of New York (Borough of Bronx) to Pelham, New Rochelle and Larchmont, and thence to a terminus 1½ miles beyond Portchester, a total distance of 25 miles. The present decision removes the last legal barrier to the building of this road, except that the company must get permission from the Board of Aldermen to cross certain streets in the Borough of the Bronx. The right of way for the entire road has been secured and the officers say that many of the contracts have been let. Of the four tracks which are contemplated, only two will be built at first. (March 20, p. 220.)

PERE MARQUETTE.—This company has sold to N. W. Harris & Co., $3,000,000 of 4½ per cent. gold bonds secured by a first lien on the Lake Erie & Detroit River Division. This division, 230 miles of road between Detroit, Port Huron and St. Thomas, is to be the connecting link in the Pere Marquette trunk line from Chicago to Buffalo.

QUEBEC TERMINAL & RAILWAY.—The railroad committee of the Dominion Parliament has reported favorably on the application of the Quebec Bridge Co., for a charter, with authority to change its name to the Quebec Terminal & Railway Company. Power was also given to connect the bridge with the Canadian Pacific and the city of Quebec on the north, and with the Grand Trunk and the Intercolonial on the south. (March 27, p. 240.)

ROCHESTER & EASTERN.—The New York State Railroad Commission has approved the proposed first mortgage of $1,500,000 on this electric line which is building from Rochester via Canandaigua to Geneva, 40 miles. The company expects to have the entire line, between Rochester and Geneva, working by November, 1903. W. B. Comstock, Rochester, N. Y., is President.

ST. LOUIS TRANSIT.—This company has made a mortgage for $20,000,000 with the Mercantile Trust Co. for the purpose of renewing certain bonds now maturing. It will be a first lien on all the property, franchises, tracks and equipment of the Transit Company. Five per cent. gold bonds will be issued.